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THE CRYSTAL PALACE ELECTRICAL EXHIBITION.

On Saturday evening last, the Prince and Princess of Wales visited the Crystal Palace for the purpose of viewing the exhibition of the electric light, their presence bringing together a large concourse of spectators. The effect of the various systems in a building so eminently suited for such a spectacle was brilliant in the extreme, and the impression produced on those who were fortunate enough to be present will not readily be effaced. We have on several occasions made allusion to the probable objects of this exhibition, and have also compared it with that of Paris from another standpoint; and now, leaving out of the question any opinions we have formed on these matters, we may say that, as a sight, it is difficult to imagine anything more beautiful. The shortcomings and partial failures which necessarily occurred at the commencement of the lighting have been apparently rectified in almost every instance, and for an exhibition of such a character it may now be considered as complete as need be. On the evening we have referred to, every competitor appeared to do his best to outvie his neighbour, the result being most creditable and successful. A certain amount of dissatisfaction amongst the exhibitors, however, appears to prevail at the evident tendency on the part of those in authority at the Crystal Palace to bring into undue prominence the American element. This however is not altogether unwarrantable, for owing to the completeness and extensiveness of their exhibits, it must be confessed that the methods of Brush and Edison are the most important of all the competing systems, both as regards extent and careful management, each being perfect in itself and not borrowing from other sources. We are speaking now of the manner in which the general public will look upon the exhibition, and in order to be successful it is necessary to study the prevailing ideas of the multitude. From a scientific point of view there are doubtless several English systems of electric-lighting equally worthy of consideration with those of Brush and Edison; but, as we have before mentioned, the scientific part of the question does not stand for much at Sydenham, therefore those exhibitors whose apparatus may be possessed of the greatest merit must not feel themselves slighted if their systems are passed by with merely a glance.

Returning to the exhibition as a whole, last Saturday saw several additions to the already numerous appliances. A number of Faure accumulators were shown in action and supplied the current for Edison's incandescent lights. Probably some idea of the lasting power of these secondary cells may now be obtained, a certain knowledge on this point being most desirable. We believe that forty or more of the new secondary cells of Messrs. Sellon and Volckmar, of which we have heard so much recently, were also used publicly for the first time in connection with numerous incandescent lamps of the Lane-Fox type, for illuminating the Alhambra Court. The British Electric Light Company had in action two very powerful incandescent lamps of their own construction, in comparison with which the ordinary incandescent lights were most feeble. It does not appear at present, however, that this kind of lamp is lasting, for the filament may go at any moment when worked to such a high degree of incandescence. Although during the evening there were several instances of the ordinary incandescent lamps being destroyed, this was doubtless due to the occasion and the desire to show this system of lighting to the utmost advantage by increasing the amount of current passing through them for the time. We have however sufficient proof that with ordinary care and attention incandescent electric lamps may be made to last for very long periods of time, and although we are only at the beginning of this new industry there are evident signs of great activity, which augur well for the future of electric-lighting by this system. The arc will be used in many places where powerful lights are required; but we think that if our streets are ever generally lighted by electricity it will be by the incandescent method. Inventors are apparently taking leave of the arc lamps and concentrating all their energies towards the ultimate perfection of lighting by incandescence.

Should the exhibition at the Crystal Palace extend to a permanency, it ought and should be the means of greatly facilitating the general introduction of electricity for many purposes other than that of illumination. It is to be hoped that it may be made worth the while of the various competitors in electric lighting to keep up their exhibits and to add to them as new ideas are brought forward. The Crystal Palace directors have now in their hands the power of recouping themselves for the reverses of past years, and of conferring a great benefit upon the public at large, and if they act with discretion the exhibition may produce valuable permanent effects. In order to insure these it is necessary that the exhibitors shall have no cause for complaint, and this can only be done by giving equal facilities to all, and also by showing them equal attention. It looks, to say the least of it, as if the authorities of the electrical exhibition had more than a passing interest in certain systems, which are chosen for special examination and demonstration when the Crystal Palace is honoured by visits from important personages. However, be that as it may, the exhibition has now assumed an importance which, although not international, yet is of a very creditable nature. It is worthy of remark that the public interest has shown itself so far, that several letters have appeared in the *City Press* to the effect that many thousands, whose only chance of seeing the electrical exhibition occurs on a Saturday, are obliged to forego the pleasure of a journey to Sydenham because they cannot afford the 2s. 6d. charged for admission on that particular day. It would be desirable on their part, if the Palace directors could see their way clear to extend the ordinary charge of 1s. to Saturday—say, once a month—if such a course would not materially interfere with their existing contracts with season-ticket holders. Or it might be advisable to keep the lights burning say an extra hour on certain Saturdays, and allow visitors to enter the Palace at the reduced admission after 8 o'clock in the evening. In the meantime, decidedly, the directors may congratulate themselves on the success attending their plans.

ELECTRIC RAILWAYS.

By Professor W. E. AYRTON, F.R.S.

Lecture delivered at the weekly evening meeting of the Royal Institution of Great Britain on Friday, March 24th, 1882, Dr. Warren de la Rue, F.R.S., in the Chair.

AN Englishman when he travels abroad is frequently in a state of worry, and one of the causes is the slow speed of the Continental trains. He feels he has paid express fare while he is only travelling at a very moderate rate. I remember once, after I had been several hours in a constantly-stopping express train, asking how an express train that stopped at every station differed from an ordinary train, and I was told—this was in Germany—"Oh! an ordinary train stops at every house." But the foreigners are not particularly dissatisfied—they see the other side to the picture, the accidents constantly occurring on British lines.

We, indeed, have grown so accustomed to the regular announcement—Serious accident on such and such a railway, several persons injured!—that we have almost come to regard accidents as inevitable, just as parents mistakingly think that the measles and whooping cough are necessary accompaniments of childhood. But in reality speed no more implies disaster than a densely crowded city implies disease. The first effect of overcrowding is undoubtedly to produce fever and other complaints. If however the knowledge and practice of the laws of hygiene increase more rapidly than the population of a town, the death rate, as we have seen, diminishes instead of augmenting. And so it is with locomotion. The stage-coach journeys of our ancestors were slow enough for the most staunch conservative, and yet the percentage of the passengers injured on their journeys was far greater than even now, with our harum-scarum railway travelling. The number of passengers has increased enormously, but the safety has increased at an even greater rate. If then we can devise methods introducing still greater security, a far larger number of passengers may travel at a far greater speed and with much less fear of danger than at present.

Accidents constitute one charge against railway conveyance, but there is another, and that is the cost. Cheap as railway travelling now is compared with the stage coach journeys of our grandfathers, the price of the tickets is still far too high for railways to fulfil even in a small degree one of their most important functions, and that is transporting labourers from parts of the country where labour is scarce to others where it is abundant and labourers in demand. Consequently, how little do our workmen understand the advantage of removing to places where pay is high instead of necessarily working where they were born.

Again, take the case of ourselves. What do the majority of us know about Russia, for example? We have read geography books, doubtless, but what of that? Did a blind man ever obtain a true conception of a green meadow or of a field with waving corn, or of a sea shore with the rolling waves, from hearing a description read out of a book? And so with us. We cannot have more than distorted, erroneous ideas about distant lands and peoples that we have never seen. We lose many practical advantages that we might avail ourselves of did we feel ourselves inhabitants of the world, and not merely countrymen of a small insular bit of it.

But how is a happier idea to be realised? We cannot expect the railway companies to lower their fares merely to benefit humanity. If however we can prove to them that the present system of railways is neither the most remunerative to themselves nor the most beneficial to the community we may hope to win the attention of railway directors whose stock question is, and quite rightly, "Will it pay?"

Those of you who have read the interesting life of Stephenson know what a struggle, what a protracted fight he had to carry one of his most cherished ideas, and that was the employment of a locomotive engine to draw the train instead of a stationary engine to pull it with ropes or chains. Stephenson saw the enormous waste of power that must necessarily arise from the friction of ropes or chains passing over pulleys. Whereas his adversaries were struck with the disadvantage of adding the weight of a locomotive to the weight of the train. Let us make an experiment or two illustrating the disadvantages of each system. Here is a cord passing over two sets of pulleys, I hang this weight of 5 lbs. on the lower pulley, yet although there is no weight attached to the other end of the cord the weight being held up by friction does not fall. And if so much friction exists with a cord passing over half a dozen wheels how much would there be if it passed over hundreds of wheels supporting it on a long line of railway? Indeed the friction and wear and tear of the ropes such as were, for example, employed on the old London and Blackwall Railway, would have been an inseparable hindrance to the development of locomotion. Consequently, since in Stephenson's day the only feasible mode of communicating the power of a stationary engine to a moving train was by means of ropes, his decision to adopt the locomotive in place of them was a perfectly correct one at the time it was made. And when Blackett, in 1812, showed that you could dispense with toothed wheels on the engine and racks on the rails, and that a proper distribution of the weight of the engine enabled sufficient friction for tractional purposes to exist between the driving wheels and the smooth rails, the whole question appeared solved, and the solution has been practically unchanged even for the most mountainous lines like that over the Rigi and that up Vesuvius, on both of which a locomotive is used, with the simple addition of the toothed driving wheel originally employed by Trevethick, in 1802.

Now let us consider the other side of the question. Here are two bottles lying on their sides, one is empty, and therefore of small mass, the other contains mercury, and therefore has a much larger mass. I give each in succession the same blow by liberating this bent spring. Observe the result—the empty bottle rolls away, while the full one hardly moves. Now why is this? It is not the result of friction, seeing that both the bottles are smooth and are resting on glass. The explanation is because the exertion of a certain force for a certain time cannot produce so large a velocity in a large mass as it can in a smaller. The mass of the locomotive therefore requires the engine to exert a greater total pulling power to get up the speed of the train in a given time, or what is the same thing, a longer time for the same force to get up the speed.

But more than this, such an extra mass necessitates in addition the constant exertion of a greater pulling force to keep up the speed on account of the friction of the wheels and rails. This may be shown as follows: Instead of keeping our train moving at a uniform speed over the ground, we will, with this simple apparatus devised by Prof. Perry and myself for experiments on kinetic friction, keep the ground moving uniformly under the train, which comes to the same thing. This wheel, which is kept in rotation by the gas-engine, represents the moving ground, and the tension of this spring the force with which this weighted jockey, which represents the train, is pulled back. The jockey has now 2 lbs. attached to it, and the tension is about $\frac{3}{4}$ lb. The weight is increased to 5 lbs., and the tension becomes 2 lbs.

The mass of the locomotive, therefore, adds to the horse-power the engine must necessarily exert to get up the speed of the train in a given time, as well as adding to the horse-power the engine is compelled to exert to prevent the speed from diminishing on account of friction. Now the weight of a railway carriage full of people is about 7 tons, whereas a railway engine weighs from 20 to 60 tons, hence the average weight of an engine may be taken as about that of six full carriages. Ten carriages compose an ordinary train, consequently the presence of the mass of the locomotive necessitates the expenditure of at least 50 per cent. more horse-power, and the burning therefore of 50 per cent. more coal than is necessary to propel the carriages alone.

And there is another most serious objection to the use of locomotive engines, perhaps even more important than the preceding. The engine is not very much larger than a carriage, and yet its weight is five or six times as great. The engine passes of course over every part of the line, consequently the whole line, all the bridges, must be many times as strong, and therefore many times as costly, and the expense of maintenance also must be far greater than if there were no locomotive. And it is not possible to make the engine much lighter, for it would not then have sufficient adhesion with the rails to be able to pull the train; in fact, you cannot much diminish the weight as long as the train is propelled as at present with only one or two pairs of driving wheels.

Attempts have been made to propel trains by blowing them through tubes, or by blowing a piston attached to the train through a tube, but all such attempts at pneumatic railways on a large scale have been abandoned. Motors worked by air compressed in cylinders on the train before starting, by fixed pumping-engines stationed along the line, have been used with considerable success by Colonel Beaumont, especially for tramcars, but the weight of the compressed air motor is still great. Transmission of power by water, although most successfully employed for stationary engines, is quite inapplicable for moving engines, as the mechanical difficulty of keeping up a continuous connection between the moving train and the main through which the water is pumped would be almost insuperable.

None of these systems, then, of dispensing with a locomotive is by any means perfect, and some other method must be sought for.

The majority of my audience are probably accustomed to look upon electricity only as a means of moving little needles or ringing bells at a distance, but the success of the recent experiments on the electric transmission of power has turned the attention of engineers to the consideration whether electricity could not successfully supplant steam for the propulsion of trains and tramcars, at any rate on branch lines; whether it could not, in fact, supply an efficient means of transmitting power, the absence of which caused Stephenson quite rightly to abandon ropes in favour of a heavy locomotive. With electricity everything like a locomotive can be dispensed with, since every wheel in the train can be used as a driving wheel just as with the present continuous brake every wheel is used to brake the train.

The whole question, however, like every similar one, is mainly a question of expense; and what we have to consider is, whether electric transmission on the whole leads to greater economy than can possibly be obtained by the employment of any kind of locomotive.

But when I speak of railway trains being propelled by electricity do not conjure up the notion of the trains going by themselves—like a witch on a broom-stick. Power must be expended in giving speed to the train, and further power in keeping up this speed, and although the expenditure of power will be much lessened by the absence of the locomotive it will be by no means nought.

Indeed, to keep up a speed of forty miles an hour with ten carriages full of people would require on a level straight line, even if there were no locomotive at all, an expenditure of about 90 horse-power. Now, power cannot be created. The total quantity of energy in the universe is perfectly constant, and all that we can effect is to devise machines for converting one form of energy into another.

In order therefore to propel a train along a railway we must either utilise the energy of coal by burning it, or employ the energy possessed by a mountain stream, or the energy stored up in chemicals and which is given out when the chemicals are allowed to combine, or the energy of the wind. Practically we employ at present only the first store for propelling railway trains, the potential energy of coal, and that is to a great extent the store of energy that we shall still draw on even when we resort to electric railways. For electric energy can be produced by the burning coal, and can be produced more economically thus than in other ways. I start this gas-engine, and an electric current is, as you see, at once produced as is proved by the deflection of this galvanometer, but that electro-motor on the other side of the room is also set in rapid rotation and works that lathe, thus showing that the electric energy conveyed along this thin flexible wire can do mechanical work.

Here you have before you the whole process of the electric transmission of power from the burning of the gas on one side of the room to the turning of the lathe on the other.

I will now convert the energy stored up in this zinc into electric energy by burning it in the battery, allow it to pass along the other flexible wire, and at the other side of the room it is converted again into mechanical work, causing this drill to be revolved at great speed, and enabling me to drill holes, as you see, upwards, downwards, or in any direction into this wood with the greatest facility.

Now, we want to consider the cost of producing power at a distance with these two methods. In the second case the energy stored up in the zinc is converted directly into electric energy in the battery, without passing through the intermediate stage of heat; whereas in the former, first, the coal is heated in the retort at the gasworks, producing waste No. 1; then the gas is burnt here in the gas-engine, producing waste No. 2; next, the gas-engine works the magneto-electric machine, producing waste No. 3; and lastly, the motion of the magneto-electric machine generates the electric current, producing waste No. 4. Now, how is it that the combined result of all these four processes, each of which is attended with waste, is more economical than the direct conversion of the potential energy of the zinc into electric energy? The answer is because, first, a pound of zinc only contains one-seventh of the energy of a pound of coal; and secondly, because a pound of zinc costs 26 times as much as a pound of coal when bought wholesale; therefore there is about 200 times as much energy in a pennyworth of coal as there is in a pennyworth of zinc. If then we can by this roundabout process of burning coal convert more than the $\frac{1}{200}$th part of the energy it contains into electric energy, this method of producing electric energy will be necessarily cheaper than the battery method. Experience shows that at the present day with the modern steam or gas-engine and dynamo-electric machine from $\frac{1}{20}$th to $\frac{1}{15}$th of the energy in the coal can be converted into electric energy. Hence the mechanical production of electric energy is from 10 to 14 times as cheap as the battery method; and it is this successful substitution of the burning of coal for the burning of zinc that has constituted one of the greatest advances in electricity during the last few years, and which has now made electric lighting commercially successful.

But you may ask, did not Faraday's persevering energy, which in 1831 led him to the brilliant discovery that a current could be produced by the suitable relative motion of a magnet and a coil of wire, settle all this half a century ago? Theoretically, yes, for this discovery of magneto-electric induction proved that electric currents could be produced by burning coal, because the continuous relative motion of the magnet and coil could of course be maintained by a steam-engine, and the steam-engine driven by burning coal. Practically, however, the problem was very far from being solved, because the machines called dynamo machines used to convert mechanical work into electric energy, were very unsatisfactory, and it was not until the construction of the Gramme machine, about 1870, that we had a dynamo capable of giving a strong continuous current of a uniform strength comparable with that produced by a galvanic battery.

The current produced by this Gramme machine, as you see, deflects the needle of this galvanometer, as if a constant current were flowing, and although the speed of the machine is now quite slow, the needle gives no indication that the current is not quite continuous. In reality, however, this apparently continuous current consists of a great number of successive currents, but which follow each other so rapidly that it requires an instrument with very rapid movement, like a telephone, to detect that this succession does not form one continuous flow of electricity. In fact this obtaining a practically constant current from a succession of rapidly following currents is the characteristic of the modern dynamo, and it was the solution of this problem by Pacinotti in 1860 which rendered the mechanical production of large electric currents commercially possible.

In fact a dynamo constructed with a Pacinotti ring, or with any of its modifications, bears to the older form of dynamo the same relationship that a double acting three-cylinder steam-engine bears to the old single acting one-cylinder engine.

On former occasions you have seen a circular saw worked in this lecture theatre by an electric current produced in the basement, and to-night you have seen the whole operation of the electric transmission of power from the burning of the gas to the working of the distant motor. I will therefore merely stop to project on the screen a photograph of one of the earliest practical applications on a large scale of the electric transmission of power, carried out by MM. Chrétien and Felix, in 1878, for ploughing a field by a stationary steam engine at a distance.

Steady currents, then, and strong currents can be produced mechanically, and far more cheaply than if produced by burning zinc in a galvanic battery. Electric energy can also, as you have seen, be easily converted into mechanical work. But whether burning coal in the furnace of a stationary engine and transmitting the power electrically to a moving train or tramcar be cheaper on the whole than using a locomotive it yet remains for us to consider.

The most complete way of measuring the efficiency of the electric transmission of power consists in ascertaining how much coal is burnt in the engine driving the generator or machine producing the current, and simultaneously how much power is being developed by the electro-motor or machine for converting electric energy into mechanical work. If however we wish to confine ourselves to the electric part of the apparatus, we measure by means of a transmission dynamometer how much horse-power is given by the steam-engine to the generator, and how much horse-power is given out simultaneously by the electro-motor; and experiments made in this way show that when the load on the motor is small, so that the motor is running nearly as fast as the generator, the loss of power need not much exceed 30 per cent., that is to say, for every foot pound of work done on the generator at one place about $\frac{7}{10}$ of a foot pound of work is done at the distant place by the motor. The reason why the motor must run very fast to obtain great efficiency is very simple, and is this. In electric transmission of power work is lost partly by friction in the generator, partly by friction in the motor, and partly by the passage of the electric current heating the wires connecting the generator with the motor as well as the wires forming the coils of the generator and motor. This waste of power from electric friction is about proportional to the square of the *difference* of the speeds of the generator and motor. On the other hand, the work put into the generator is about proportional to its speed multiplied by the difference of speeds and the work given out by the motor is also proportional to its speed multiplied by the difference. Hence by making the speed of each very great and the difference comparatively small, we can make our motor give out work as rapidly as we like with comparatively little waste from electric friction. Another way of measuring the efficiency of electric transmission of power, as far as loss from electric friction is concerned, consists in measuring the current sent along the circuit when the motor is stopped, next the current when the motor is allowed to run at any particular speed, and then dividing the difference between the two currents by the first current. In this way we will proceed to make some measurements of the efficiency [Experiment performed]:—When the motor was stopped by a brake, the current, measured on an Ayrton and Perry's ammeter, was 8·9 ampères; when the motor was running slowly it was reduced to 6·7, and when running very fast with a light load the current was only 1·8, the gas-engine and the magneto-electric generator being kept running at a constant speed. Hence at the low speed $\frac{6\cdot7}{8\cdot9}$ or 75 per cent. of the whole energy, was wasted in heating the wires, while when the motor was running at the high speed only $\frac{1\cdot8}{8\cdot9}$ or 21 per cent. of the work done by the gas-engine on the generator was wasted from the same cause. Disregarding, then, mechanical friction, the efficiency in the first case was only 25 per cent., but in the latter it was raised to 79 per cent. by the electro-motor running at a high speed with a light load. Of course the real efficiency of the whole operation is not as high as this, as mechanical friction must be taken into account, but the experiment is quite sufficient to show the economy arising from running the motor at a high speed, and why it is that, therefore, for slow moving tramcars or indeed even for railway carriages with their ordinary wheels, the motor must revolve much more rapidly than the wheels, and so cannot be applied directly to them without the employment of speed-reducing gearing.

One reason why electric transmission of power can be effected with so little waste is because electricity has apparently no mass, and consequently no inertia; there is therefore no waste of power in making it go round a corner, as there is with water or with any kind of material fluid, or with ropes. In many respects the flow of electricity along a wire resembles the flow of water through a pipe, the current or quantity flowing per second past any section remains constant throughout the whole length of the wire or pipe, and the electricity loses potential just as water loses head, but there is this one great difference between the two. When water goes round a bend there is waste of energy, the amount of which depends partly on the velocity of the water and partly on the shape of the bend. If, for example, there are two or more bends in a pipe in opposite directions more power is lost than if there is a continuous bend in the same direction; this however is not the case with a *steady* electric current, for bends make absolutely no difference in the resistance of a wire to the flow of a steady current. The analogy between electricity flowing through a wire and water through a pipe is greater if the current of electricity is constantly being stopped and restarted or being constantly reversed, since in this case bends in the wire may very considerably interfere with the flow. Hence one of the reasons that electric lighting by reverse currents is not so economical as lighting by a continuous current. But for a steady flow of electricity through a wire the analogy with the flow of water through a pipe is only complete when the flow of water is extremely slow.

And not only can power be transmitted electrically with as little waste along the most tortuous path as along a straight one, but another reason why electro-motors are so valuable for travelling machinery is on account of the light weight of the motor. Experiment shows that one horse-power can be developed for 50 lbs. of dead weight of electro-motor, a result immensely more favourable than can be obtained with steam, gas, or compressed air engines.

At present we have been dealing with only one form of loss of power—namely, the loss produced by the heating of the conducting wires by the passage of the electric current; but there is another kind of loss that must not be neglected, and which may be very serious in the case of electric railways—the loss arising from actual leakage of the electricity through defective insulation. When power, for example, is transmitted from one place to another by water pumped through pipes, not only is there waste from the friction of the water, but there may be serious waste from actual leakage of the water at defective joints.

To send an electric current through a distant instrument, two wires, a "going" and "return" wire must be used, insulated from one another by silk, gutta-percha, india-rubber, glass, porcelain, or some similar substance. One of the wires may rest bare on the ground, or in water, or may be the earth itself, provided the other be well insulated from the ground.

If the distant electro-motor be not only driving some machine, but is itself bodily movable, there must be some means of keeping up continuous connection between the two ends of the motor and the going and return wires. In the case of this drill the mere flexibility of the wires is sufficient, but for an electric train or tramcar, the simplest plan of course is to use the two rails as the two wires, and make connection with the motor through the wheels of the train, the wheels on one side being well insulated from those of the other, otherwise current would pass through the axles of the wheels instead

of through the motor, and no motion would be produced. It was this simple plan that was employed in all the early model electric railways, and, indeed, this is the plan at present employed in Siemens' Lichterfelde electric railway at Berlin, the insulation, although the rails were merely laid on wooden sleepers, having been found sufficient for the short length—1½ miles.

The car is similar to an ordinary small tramcar, holding 20 passengers. It can easily go at the rate of 20 miles an hour, but as the German authorities, after considerable deliberation, decided that it must rank as a one-horse tramcar, the average speed is limited to 9¾ miles, and the maximum to 12$\frac{4}{10}$ths miles per hour. The photograph now projected on the screen shows the actual arrangements of motor, rails, &c.

In the Siemens electric railway shown in the grounds of the Berlin Exhibition of 1879—and here I must add my tribute to the pioneering enterprise of the family of Dr. Siemens for having constructed this the first electric railway that carried passengers—and which was again used last year at the Crystal Palace, Sydenham, both the rails were employed as the return wire, and a third insulated rail rubbed by the moving train conveyed the current to the electro-motor, as may be seen from the photograph now projected on the screen. The next photograph shows the side view of the carriage and the motor. The length of this first circular line when at Berlin was about 900 yards, and the gauge 3 feet 3 inches. A dynamo machine mounted on a carriage by itself served as a locomotive, and the passengers were conveyed in three carriages, each holding six passengers, as seen in the photograph now projected on the screen. At a speed of about 7 miles an hour 3 horse-power was given out by this motor.

In the Paris electric tramway, which ran along the Champs Elysées last year, carrying 50 passengers to and from the Electric Exhibition, as well at in the tramway between Charlottenburg and Spandau, two thick overhead insulated wires, something like thick telegraph wires, were employed, as may be seen from the photograph now projected on the screen. These two thick wires were connected with the generator of electricity in the exhibition at the end of the tram line, and the current was led to the motor on the moving car by two short light wires attached to the car, and which pulled along two little metallic carriages running on the suspended wires, and consequently making continuous electric contact with them.

Now let us consider the amount of waste of power from electric leakage with these various systems. If a wire be well insulated from the ground, except at its distant end, the current will pass along its whole length, and return by the earth to the other end of the generator, if that be also connected with the ground. But if the going and return wire be both bare, and laid on the ground, like the two rails on the Lichterfelde railway, what will happen? If the wires be short and the ground be fairly dry, almost all the current will go along the whole length of the one wire and come back by the other, and scarcely any of it leak from wire to wire through the earth, because the resistance of the wires themselves is so much less than the resistance between either of them and the dry ground. If however the wires be long, or the ground moist, a large portion of the current will leave the going wire and come back by the return wire, without passing at all through the junction of the wires at their ends, and the longer the wires the more easy, relatively, is it for the electricity to go to the ground than to travel along the metallic circuit. Exactly in the same way, if a water pipe be leaky along its whole length, the longer the pipe the less will be the proportion of the quantity of water that will arrive at the other end compared with the amount that enters the pipe.

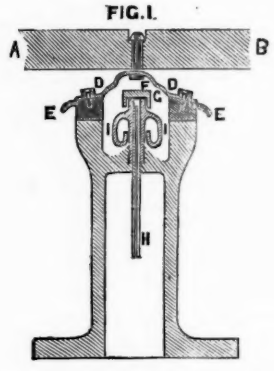
For example, at the present moment the Gramme machine is sending a current which works the distant motor turning the lathe. A portion of the going wire is, as you observe, wrapped round this bit of wood, and a portion of the return wire round this other piece of wood. As the two pieces of wood are dry there is very little leakage from the wire on the one to the wire on the other, although the wire wrapped round each is bare. If, however, without allowing these pieces of wood to touch one another, I immerse them in this vessel of water, I shall produce the same effect as if a storm of rain fell on the rails of an ordinary electric railway. Now observe what happens. As I immerse them the motor begins to run more slowly, and now the motor stops altogether, so much of the current in fact leaking from the going to the return wire through the water, that sufficient does not pass through the distant electro-motor to keep up its motion.

It is quite clear that the *bare* rails resting on sleepers on the ground could not successfully be employed for long railways, as the waste of power in leakage would more than compensate for the absence of a locomotive. It is also doubtful whether a third rail, if only a small distance above the ground, could be well insulated for a great length. If raised overhead, as in the Paris tramway, the insulation may be all that can be desired; but I fear that although the running connection may succeed well for a slow-moving tramcar, it would not be feasible for a train going at the rate of 60 miles an hour. Consequently Professor Perry and myself have for some time past been working out practical means for overcoming these difficulties, and we have arrived at what we believe is an entirely satisfactory solution. Instead of supplying electricity to one very long, not very well insulated rail, we lay by the side of our railway line a well insulated cable, which conveys the main current. The rail, which is rubbed by the moving train, and which supplies it with electric energy, we subdivide into a number of sections, each fairly well insulated from its neighbour and from the ground; and we arrange that at any moment only that section which is in the immediate neighbourhood of the train is connected with the main cable; the connection being of course made automatically by the moving train. As then leakage to the earth of the strong propelling electric current can only take place from that section or sections of the rail which is, or are, in the immediate neighbourhood of the train, the loss of power by leakage is very much less than in the case of a single imperfectly insulated rail such as has been hitherto employed, and which if of great length, with its correspondingly large number of points of support, would offer endless points of escape to the motive current.

Dr. Siemens has experimentally demonstrated that an electric railway can be used for a mile or two; Professor Perry and myself, by keeping in mind the two essentials of success, viz., attention to both the mechanical and electrical details, have, we venture to think, devised means for reducing the leakage on the longest railway to less than what it would otherwise be on the shortest.

For the purpose of automatically making connection between the main well insulated cable and the rubbed rail in the neighbourhood of the moving train, we have devised various means, one of which is seen in the following figure.

FIG. I.



A B is a copper, or other metallic, rod resting on the top of, and fastened to, a corrugated tempered steel disc, D D, (of the nature of, but of course immensely stronger than the corrugated top of the vacuum box of an aneroid barometer), and which is carried by, and fastened to, a thick ring, E E, made of ebonite or other insulating material, indicated as in the following figures by being sectioned with lines drawn very close together. The ebonite ring is itself screwed to a circular cast-iron box, which latter is fastened to the ordinary railway sleepers. The auxiliary rail, A B, and the corrugated steel discs, D D, have such flexibility that two or more of the latter are simultaneously depressed by an insulated collecting brush or roller carried by one or by each of the carriages. Depressing any of the corrugated steel discs brings the stud, F, which is electrically connected with the rod, A B, into contact with the stud, G, which is electrically connected with the well-insulated cable.

As only a short piece of the auxiliary rail, A B, is at any moment in connection with the main cable, the insulation of the ebonite ring, E E, will be sufficient even in wet weather, especially if it be provided with a lip as shown in the figure, and since the box is high the insulation will be sufficient even if the line is flooded or snow be accumulated on it; but the insulation of G, which is permanently in connection with the main cable, must be far better. For this purpose we lead the gutta-percha, or india-rubber covered wire coming from the main cable through the centre of a specially formed telegraph insulator, and cause it to adhere to the inside of the earthenware tube forming the stalk. And as, in addition, the inside of each contact box is dry, a very perfect insulation is maintained for the lead coming from the main cable. Consequently as all leakage is eliminated except in the immediate neighbourhood of the train, this system can be employed for the very longest electric railways.

Fig. 2 shows the arrangement for making the insulated joints between the various sections of the rubbed rail. Sometimes we

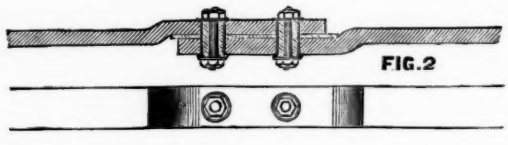


FIG. 2

modify the preceding arrangement by attaching the auxiliary rail to the moving train, in which case on the top of each corrugated steel disc is merely fixed an elastic fork, which is slightly bent forwards and downwards, depressing the disc and completing the contact as the train is passing.

Fig. 3 shows the longitudinal and transverse section of the contact box when the main cable, which may be insulated with gutta-percha or india-rubber or lapped with hemp and immersed in oil, is placed inside the flexible rail which then takes the form of a tube. In this case the metallic stalk of the insulator passes through the insulating coating of the cable, and is screwed into the conductor, making electric contact with it, and the whole is fixed in position with insulating cement. The tube, the cable, the rod, and the insulator, as well as the centre of the corrugated steel disc are thus all rigidly fastened together, and are depressed as one by the passing train, which thus brings the stud, G, into electric contact with F. This latter being connected by a slightly flexible metal band, S S, with the disc and metallic tube, serves to temporarily connect the main well insulated cable with the metallic tube, and so supplies electricity to the passing train. The insulation of the rod, P G, which is always in connection with the conductor of the main cable, is from the arrangement shown

in the figure very good, but as the tube and disc are only occasionally connected with the main cable it is sufficient to support them on an insulating earthenware box bolted to the sleeper, or the whole may be buried with only the top projecting above ground.

Fig. 4 shows a modification of the arrangement, when instead of the

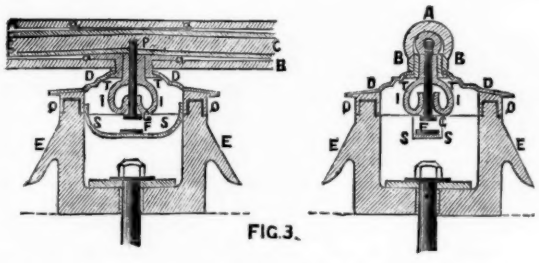


FIG. 3.

main cable being insulated with gutta-percha or india-rubber, it is merely covered with cotton or hemp, and immersed in a pipe containing anhydrous paraffine oil, in accordance with the plan successfully employed by Mr. Brooks. The contact between F and G will, in this case, be made between two surfaces immersed in paraffine oil; but some experiments made by Prof. Perry and myself, show that while even a very thin layer of paraffine oil has a very great resistance, the resistance between two metallic surfaces wetted with the oil, and

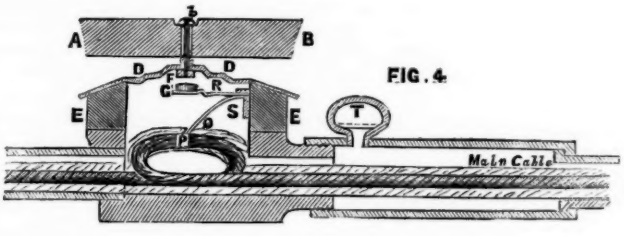


FIG. 4.

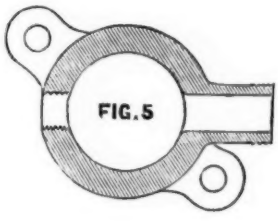


FIG. 5.

pressed together in it with a very small pressure, is comparatively trifling, so that such a contact in oil can well be made. A special form of coupling, shown in the figure, is used to connect the pipes together, and of such a length that on unscrewing the coupling, a defective piece of pipe can be removed and replaced with a good piece, or a defective piece of cable can be cut out, and a good piece pulled in in its place, sufficient slack being coiled up in the boxes to enable the joints to be easily made.

As the flow of liquid through the iron pipes is very slow, even under considerable difference of pressure, since the wire covered with cotton or hemp nearly fills up the pipe, there will be but little leakage, even when a pipe is open. On the other hand, to avoid the oil which is practically confined in each contact box bursting open the box when the corrugated steel top is suddenly pressed down by the weight of a passing train, an air spring, T, is attached to every coupling, and into which the oil is temporarily pressed during the depression of the top of the box. Fig. 5 shows the plan of the preceding contact box.

The existence of these contact boxes at every 20 to 50 feet also enables the train to graphically record its position at any moment on a map hanging up at the terminus, or in a signal box or elsewhere, by a shadow which creeps along the map of the line as the train advances; stops when the train stops; and backs when the train backs. This is effected thus: In addition to the small insulated sections into which we divide the rubbed rail, the whole line is as usual divided into long sections, which are blocked, varying in length from a few hundred yards to several miles, depending on the amount of the traffic. For each section a thin insulated wire goes from the terminus, signal-box, or other place where is the map of the line and enters into each of the contact boxes in that particular section, and as the train passes along, not only is the main contact between F and G automatically made, as already described, but an auxiliary contact is also completed by the depression of the lid of the contact box, and which has the effect of putting, at each contact box in succession, an earth fault on this insulated thin auxiliary wire. And just as the position of an earth fault can be accurately determined by electrical testing at the end of the line, so we arrange that the moving position of the earth fault, that is the position of the train itself, is automatically recorded by the pointer of a galvanometer moving behind a screen or map, in which is cut out a slit representing by its shape and length the section of the line on which the train is, as shown in fig. 6. In addition, then, to the small sections of 20 ft. or more into which our auxiliary rubbed rail is electrically divided, there would be certain long blocked sections one mile or several miles in length, for each of which on the map a separate galvanometer and pointer would be provided. [Experiments were shown of this system of enabling the progress of a train to graphically record itself.]

In the preceding systems there are several contact boxes in each section of the insulated rubbed rail, and several sections of the insulated rail in each section of the line blocked, but in the next system the rubbed rail is simply divided electrically into long sections each of as great a length as the particular system employed to insulate the rubbed rail will allow. In this case we arrange that the electric connection between the main cable and the rubbed conductor shall be automatically made by the train as it enters a section, and automatically broken as the train leaves a section. The model before you is divided into four sections, each about 11 ft. long, and you see from the current detectors that as the train runs along it puts current on to the section just entered, and takes off current from the section just left. It may be mentioned that the detectors are merely for the purpose of showing you that the system is working properly, and form no essential part of it.

I now by means of this small handle attached to the carriage reverse the connections between the revolving armature and the fixed electro-magnets of the motor on the carriage. The carriage at once begins, as you see, to run back, and from the current detectors you observe that, exactly as before, current is put automatically on to each section entered and taken off from each section left, so that whether the train be going forwards or backwards, leakage can only take place from the one section on which the train at any time happens to be.

Now, what would happen supposing from some accidental cause the field magnets of the dynamo machine at the end of the line become reversed in polarity, so that the current flowing along the main circuit becomes permanently reversed? Would all the trains run the wrong way, producing endless confusion? Not at all; for on reversing the current flowing through the line you observe I cannot reverse the direction of motion of the train. The direction of motion is solely under the control of the engine-driver on the train. In fact, a dynamo machine used as a motor always works one way, no matter in which direction the motive current flows through it, and the only way to reverse its motion is to reverse the connection between the revolving armature and the fixed electro-magnets on the train. No

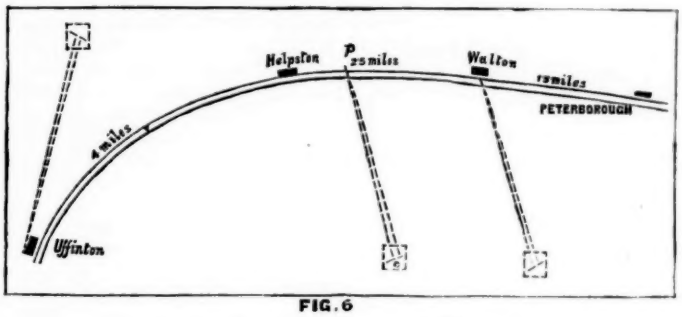


FIG. 6.

accident can then happen from some irregularity in the main dynamo machine.

In the model before you the contacts are made by the lever of a key which is pushed forwards or backwards by the passage of a train. The movement of any lever puts current on to the section entered, takes off current from the section left, unlocks the levers on each side of it and blocks the preceding section. In an actual railway such a lever would, of course, be rapidly smashed by the rapidly moving train, hence in our real electric railway we employ two plungers at each contact box, and which are slightly depressed in succession by the moving train, the order of depression taking the place of the direction of motion of the contact lever in the model. Hence we guard against the shocks and strains produced by a rapidly moving train as well as by its possible swaying from side to side, arising from the rails having been unevenly worn.

But more than this, not only does the train take off current from the section 1 when it is just leaving it and entering section 2, but no following train entering section 1 can receive current or motive power

until the preceding train has entered section 3. In fact, any section 1 is *absolutely blocked* as long as a train is on the section 2 in advance. To test this I start this express after the goods in front. Observe what happens. The express is catching up the goods; but when it runs into the section first behind that in which the goods happen to be the express pulls up. And you see, whether I allow the model goods train to advance, or whether I stop it, or whether I let it run back, the express remains immovable a section behind. Now, let the goods run on; observe what happens as it leaves section 2 and enters 3. The express in 1 now begins to go on rapidly, runs over 1 and enters 2; but now it is again automatically pulled up, and remains immovable on section 2 as long as the goods is on 3. In this way I allow them to follow one another, the express being always automatically, as you see, kept at a safe distance behind the goods train. On arriving at this siding we now shunt the goods into it; and when the goods has passed the contact box on the siding, and is therefore safely on it, the block is automatically removed, and the express now runs safely round and round the circular railway at considerable speed.

Now why does the following train when it runs on to a blocked section pull up so quickly? The reason is because it is not only deprived of all motive power, but is powerfully braked, since when electricity is cut off from a section the insulated and non-insulated rail of that section are automatically connected together, so that when the train runs on to a blocked section the electro-motor becomes a generator short-circuited on itself, producing, therefore, a powerful current which rapidly pulls up the engine. [Experiments were then shown of the speed with which an electro-motor, which had been set in rapid rotation and then deprived of its motive current, pulled up when its two terminals were short-circuited.]

Whenever, then, a train, it may be even a runaway engine, enters on a blocked section, not only is all motive power withdrawn from it, but it is automatically powerfully braked, quite independently of the action of the engine-driver, guard, or signalman. No fog, nor colour-blindness, nor different codes of signals on different lines, nor mistakes arising from the exhausted nervous condition of overworked signalmen, can with this system produce a collision. The English system of blocking is merely giving an order to stop a train; but whether this is understood or intelligently carried out is only settled by the happening or non-happening of a subsequent collision. Our Absolute Automatic Block acts as if the steam were automatically shut off and the brake put on whenever the train is running into danger; nay, it does more than this—it acts as if the fires were put out, and all the coal taken away, since it is quite out of the power of the engine-driver to re-start his train until the one in front is at a safe distance ahead.

But all trains will undoubtedly be lighted with electricity; must, then, the train be plunged into darkness when it runs on to a blocked section to which no electric energy is being supplied? No! If some of the electric energy supplied to the train when it is on an unblocked section be stored up in accumulators, such as are at present used on the Brighton Pulman train, the lamps will continue burning even when the train has ceased to receive electric energy from the rubbed rail.

When, then, we commit the carrying of our power to that fleet messenger to which we have been accustomed to intrust the carrying of our thoughts, then shall we have railways that will combine speed, economy, and safety; and last, but not least to us Londoners, we shall have the entire absence of smoke, the presence of which nearly causes the convenience of the Underground Railway to be balanced by the pernicious character of its atmosphere.

THE NEW ACCUMULATOR OF MESSRS. SELLON AND VOLCKMAR.

Now that secondary batteries, whether containing new ideas, or merely consisting of slight improvements on well known forms, are attracting so much attention in the electrical world, we feel that we cannot do better, in noticing the secondary battery of Messrs. Sellon and Volckmar, than to give first an advertisement emanating from Paris, and issued by the "Société Anonyme La Force et la Lumière" on the 24th of March, concerning the Faure Accumulators, and which advertisement has appeared in the London daily press.

It reads as follows:—

THE FAURE ACCUMULATOR.—Notice.—For some time past the advent has been pompously announced of a new Secondary Battery, said to be infinitely superior in capacity and durability to that of Faure.

The construction of this Battery is perfectly well known to the undersigned, although it has not yet been shown out of the laboratory where it was made. It is neither better nor worse than a Faure Battery, inasmuch as it is a Faure Battery, made by discharged employés and workmen from the Faure factory in Paris.

It is composed of perforated or corrugated plates of lead, on which are encrusted or intercalated oxides of lead, minium of litharge, lead dross, or finely divided or reduced lead. The professed inventor of this Battery (whose plagiarism will be proved at the proper time) naïvely imagines that by this process, which has been long ago described and employed, he can do without asbestos, felt, or other substances destined to serve as support to retain the reduced lead and peroxide in their places, and even goes so far as to minutely describe in his patent the details copied from the patent accorded to M. Faure.

Finally, whether made with or without supports, these batteries cannot be made in Great Britain or elsewhere without proper licence and permission from the owners of the Faure Patents.

THE PRESIDENT OF THE SOCIÉTÉ ANONYME LA FORCE ET LA LUMIÈRE.

Concerning the validity of these statements, which may or may not be true, we do not intend to discuss the matter at the beginning, but merely to state in the first place what we have seen. On the Friday evening previous to the visit of the Prince of Wales to the Crystal Palace Electrical Exhibition, 40 of these cells were there shown in action, but only to a limited degree, as they had not been fully charged. However, during the following evening they were in full working order, and were considered to be most satisfactory in their operations.

These secondary cells are made of various dimensions, the smaller ones having an internal capacity of $\frac{43}{100}$ of a cubic foot, the weight of metallic substance (?) in each being 62 lbs., and the solution consisting of 8 or 10 lbs. of acidulated water. As to the durability of these new cells, it is said that they will probably last for 12 or 18 months without attention, and then it will be only necessary to replace the positive plates, which may be done without destroying or disturbing the negatives. The facility for these repairs when necessary is very great. When looking at these cells, the difference between them and those of M. Faure is not at first sight very apparent, the only visible alteration being the absence of any felt or serge wrapping round the metallic plates, which are here kept apart from one another by slips of wood.

Each of these cells will give out for an hour 1 horse-power of energy. We are told that the short circuiting of the plates, which is said to form one objection to another system, is obviated in these cells by their mechanical construction. The electromotive force per cell is given as 2·15 volts, and the internal resistance about 0·005 ohms. We are informed that the loss or leakage from these batteries when idle is very small. The larger cells will give out 5 horse-power of energy for one hour, and the weight of each, including both metallic plates and solution, is about 300 lbs. It is claimed that by means of the Sellon and Volckmar secondary batteries about three times greater power can be obtained than is possible from the Faure system, weight for weight. These new cells can be seen in operation at the Crystal Palace, where they will be employed for producing the current to supply the incandescent lamps of Lane-Fox in the Alhambra Court. In reference to the construction of these cells, the details of which cannot yet be given, we are assured on good authority that they are quite different from those of M. Faure, and that the statements contained in the foregoing advertisements, if they refer, as Mr. Sellon supposes, to his accumulators, are therefore utterly unfounded. In fact, some of the Sellon plates were manufactured before the Faure patent was published. We are glad to be able to state that these secondary cells of Messrs. Sellon & Volckmar will shortly be laid before a scientific committee formed to consider the subject from all points. We would suggest that the test for loss or leakage when the cells are idle should have careful consideration for short and long periods of time. The Faure accumulator has already been carefully experimented upon in Paris by several well-known French scientists, and it will be highly interesting to compare their results with those obtained from the Sellon and Volckmar secondary cells, which we believe will shortly be available. In the mean time it appears that a real improvement in this branch of electrical science has been effected, but we have not yet seen sufficient of the new cells to speak confidently as to their ultimate value.

THE EDISON ELECTRIC LIGHT COMPANY, LIMITED.—It is said that the whole of the first issue of the capital of the above company has been privately subscribed by forty gentlemen, friends of the directorate.

TELEPHONY.—The paper on "Telephony" which should have been read by Lieut.-Col. Webber before the Society of Arts last week is postponed till May 3rd.

THE AUTOMATIC TYPE PRINTING TELEGRAPHIC APPARATUS OF SECONDO ROOS AND FRANCESCO OSTROGOVICH.

The object of this apparatus is to attain great rapidity of transmission, and it is based on the apparatus of Professor Hughes, with type wheels, printing by continuous movement and correction of each signal printed. By keeping the same time for the mechanical operations the same duration is maintained for the current of the line, a duration necessary in order to communicate directly to any distance.

This is effected in two ways :

(1) By rendering the manipulator automatic.

(2) By multiplying the alphabets on the type wheels and rendering the chariot multiple also.

The automatic working is obtained by a perforated band of paper, which establishes communications in the distributor, so that at the passage of the chariot the apparatus is thrown out of gear at the moment required for the printing of the signal. In order to avoid the inconvenience of having a band of paper of excessive length or width, the system has been rendered practical by taking into account the number of combinations that can be formed with 8 units combined two and two. This number being 28, exactly equal to the number of signals in Hughes' apparatus, a band from 3 to 4 centimetres in width, and of the length of the printing, is sufficient for transmission.

The perforated band has always two holes on each transverse row, determined by a third hole in the middle of the band, which serves as a sort of rack to make the paper advance.

The two holes in the paper band, *a*, fig. 1, allow two of the eight points of a row of pins, *b*, figs. 1 and 2, to pass and establish, by means of small levers, *c*, fig. 2, pressed by the two points, communications in the distributor, A, fig. 1.

The distributor, A, fig. 3, is composed of a series of 56 contacts, *a*, arranged in two rows of 28, corresponding with one another ; these contacts are connected with the 56 spokes, *b*, which are placed on the lower part of the distributor ; these 56 spokes in groups of 7 are in communication with 8 circles, *c*, which, by means of 8 terminals, *d*, establish an electrical communication with the 8 points or contacts, *e*, of the manipulator.

The chariot, B, has two points, *f*, fig. 3, or rubbers insulated from one another, and corresponding to the two rows of contacts of the distributor.

The distributor is combined in such a manner that each combination is only reproduced once in the 28 double contacts of the distributor.

In fig. 3 we can trace the circuit, taking as a starting point one of the springs which establish communication with the battery. The current which passes from the spring, *g*, by the upper point of the chariot through one of the contacts of the upper row, goes to one of the lower circles of the distributor, and then passes to one of the lower levers of the automatic apparatus, and returns to another circle of the distributor through the upper comb, which is entirely metallic. It then proceeds by the spoke to one of the contacts of the lower row, which corresponds to the first contact of the upper row, and passes by the second point of the chariot to the upper spring, *h*, which completes the circuit with the electro-magnetic apparatus and the battery. Every time the band of paper establishes a communication in the distributor in this manner, the apparatus works when the points of the chariot pass over the two contacts determined by the combination of the holes of the perforated band.

The automatic apparatus, as it has just been described, can also be adapted to the Hughes instrument, and to all others of the same type. By means of the automatic manipulator, we obtain the full speed of transmission of which an apparatus is susceptible, or its full amount of work ; but it is still possible to increase this amount by making the chariot multiple, *i.e.*, by placing several couples of points at equal distances, so that an electrical communication being established in the distributor, the chariot can close the circuit by any one of the couples of points, and consequently by the one which first passes : thus the speed of transmission is evidently increased. The type wheel is furnished with as many alphabets as there are couples of points on the chariot, and in the model exhibited at the Crystal Palace Electrical Exhibition there are three alphabets. By arranging the letters on the type wheel in the order most commonly followed by these letters, in words and at distances which allow of their being taken immediately one after another, the result obtained from the apparatus is again sensibly increased.

As the most convenient order varies necessarily for different languages, a method of arrangement has been adopted which gives a good average for the languages most used in telegraphy. As regards the mechanical operations, they are performed, as in the Hughes apparatus, in $\frac{1}{7}$th of a revolution of the type wheel ; consequently the chariot at the most cannot be more than a septuplex arrangement, and the transmission of the movement, the regulation, and the coupling are not materially different.

The unlocking is effected by means of an electro-magnet, which neutralises the action of the permanent magnet, and allows the armature to strike the stop of the disengagement, so as to set it free. The armature is brought back to its place by a lever which moves in a sinuous groove, made in the axle of the printing apparatus. The part which is essentially different is the correcting mechanism, which consists of a wheel with sharp teeth, equal in number to the signals on the type wheel, and a cog wheel which moves freely on the axle of the type wheel, but which gears with a pinion placed on the printing axle. This second wheel is furnished with seven hammers, placed at equal distances, and with the striking part corresponding in form to the spaces between the teeth in the correcting wheel.

At the commencement of the movement a cam, placed on the printing axle, forces one of the seven hammers to advance into the hollows of the correcting wheel, and effects by a very gentle rotary movement the correction required. The printing is effected by means of a cam placed on the same printing axle, and acts upon the inking roller by means of a bent lever, at the very moment in which the correction is completed. A tooth on the same printing axle, which acts upon a wheel in the form of a Maltese cross, causes the printed paper to advance, during part of the revolution of the said axle, by means of a cylinder with little grooves placed on the said wheel, and slightly pressed by another free cylinder. Finally another cam, also on the printing axle, works the row of pins.

The three alphabets are placed on one wheel, and the numbers on another parallel to the first. This necessitates transferring the inking roller from one wheel to the other every time it is required to pass from letters to figures, and *vice versâ*. This is provided for by special mechanism, consisting of a little wheel moving freely on an axle, and gearing with the free wheel of the axle of the type wheel in the ratio of 7 to 2, *i.e.*, in a ratio which is double that between the pinion of the printing axle and the said free wheel. The little wheel bears two rubbers, which by teeth set inwards either meet or do not meet (according to the position of the inking roller relatively to the wheel of types) the tooth of a collet, which causes the little axle to perform half a revolution, but which can be displaced longitudinally on the axle by means of a double inclined plane fixed to the frame, and two points placed on the collet for the purpose.

Another collet placed on the same axle supports the strip of paper to be printed, and by means of a point which works in a groove made on the axle, half in one direction and half in the other, passes longitudinally over the axle, and by its movement changes the position of the inking roller, bringing it under one or other of the type wheels, as required. The correcting wheel bears six little squares, suitably placed, and every time it is necessary to displace the inking roller one of these squares forces one of the rubbers to meet the tooth of the inner collet. The latter causes the axle to make a half revolution, and by this movement the collet, which supports the paper and guides the inking roller, being constrained to follow the groove made in the axle, is displaced, and passes from one type wheel to the other. The double inclined plane in its turn displaces the inner collet, and by this displacement can only be met by the opposite rubber, which will then act only when it is necessary to again displace the inking roller.

FIG.I.

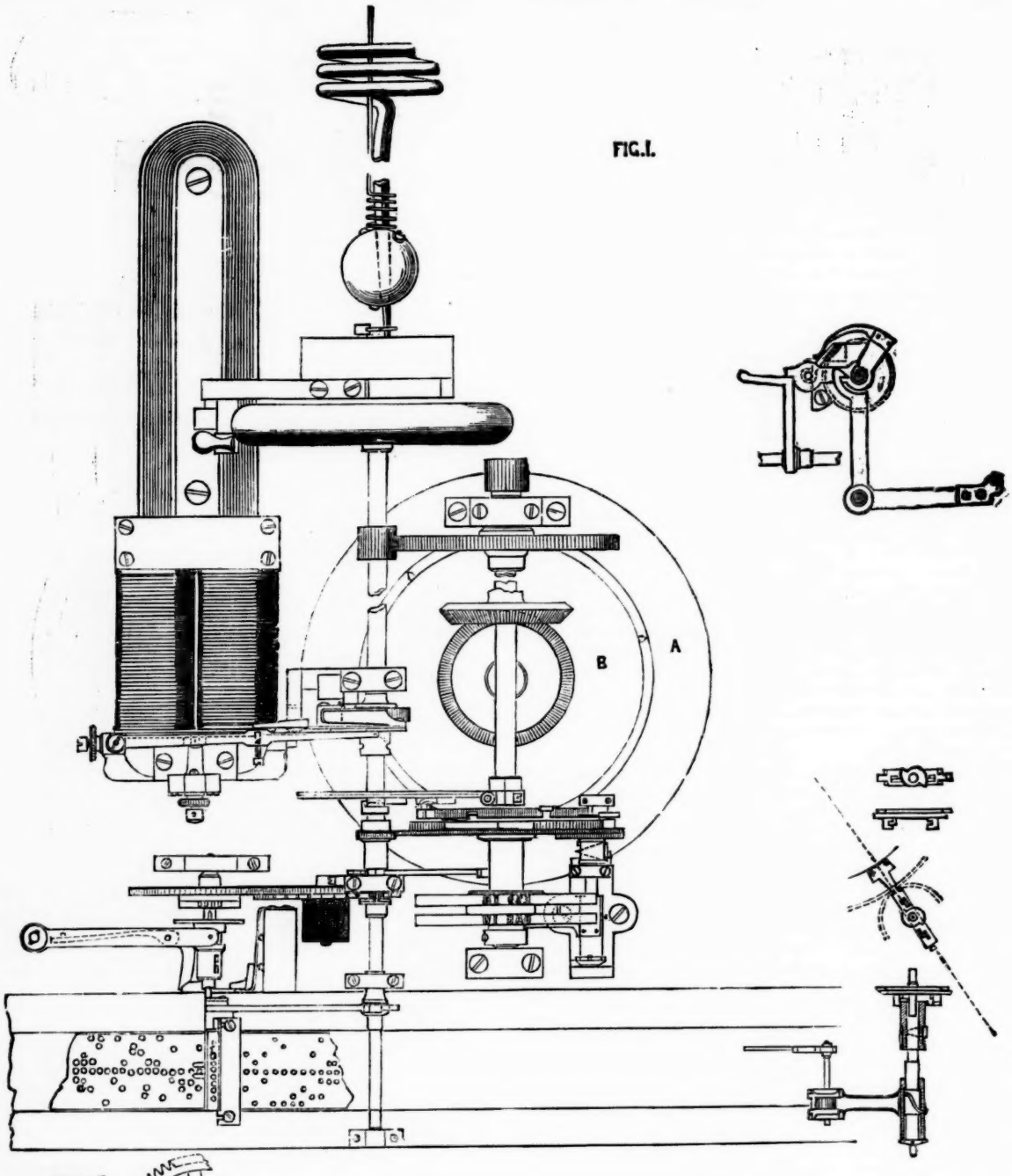


FIG.2ª

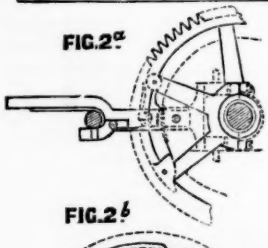


FIG.2

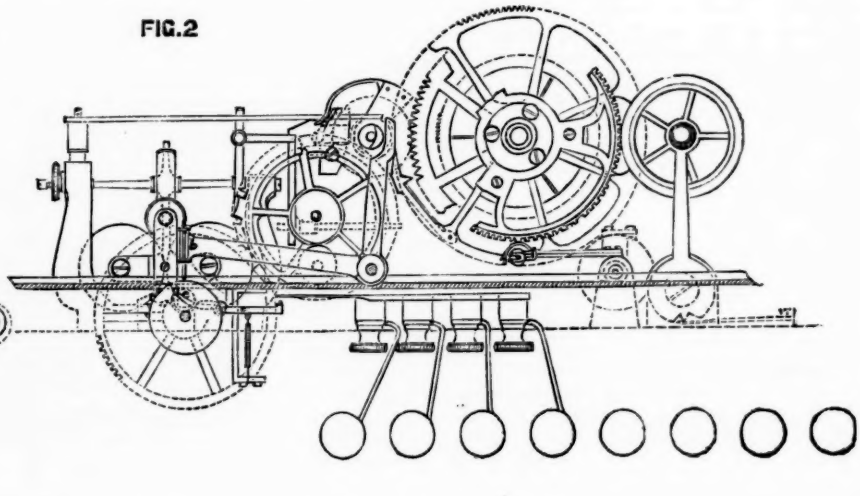
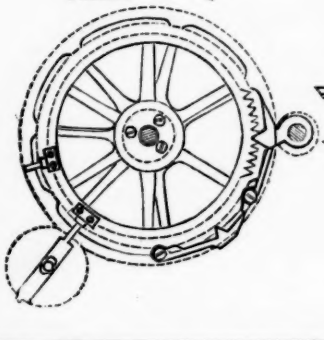
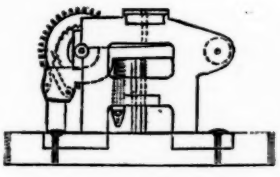


FIG.2ᵇ





Elevation of Fig. 4 at (A).

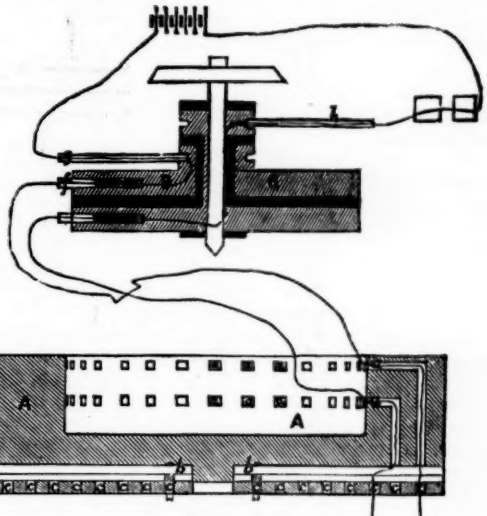
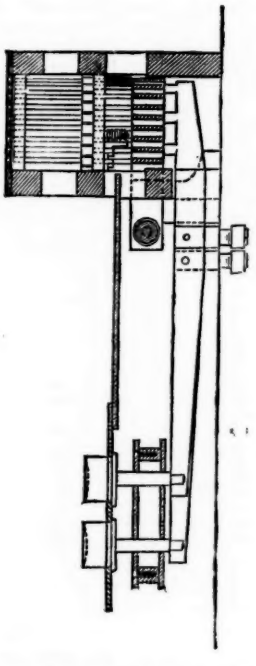
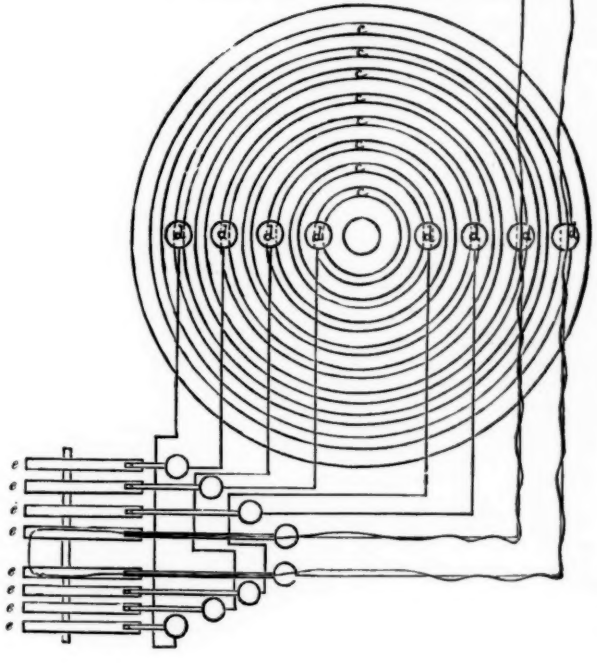


FIG. 3.



End Elevation of Fig. 4 at (B).



(A)

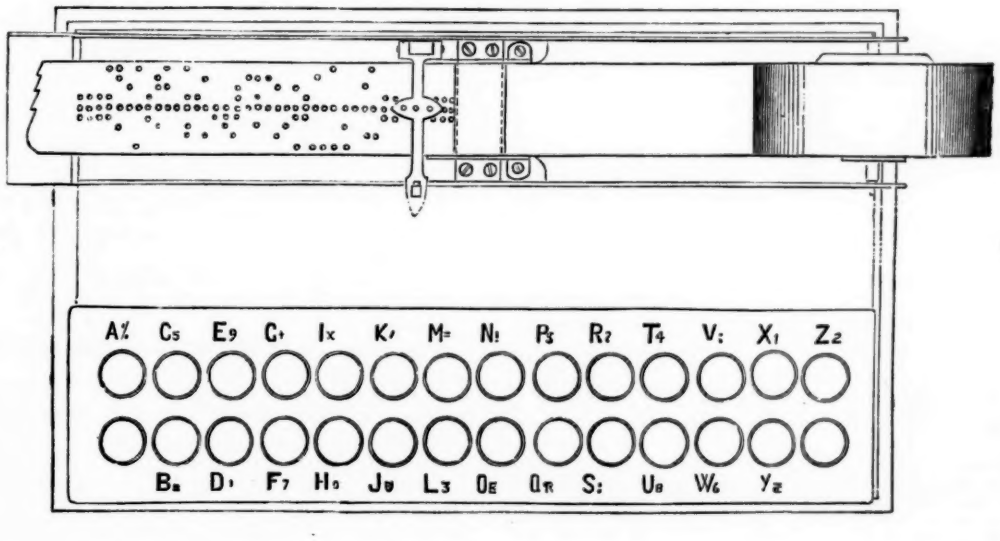


Fig. 4.

(B)

The zero-setting is obtained by an arm on a collet moving freely on the axle of the type wheel, which meets a stop placed on the ratchet of the wheel of correction, stopping it in the position desired for the zero. A double inclined plane, situated half on the free axle and half on the arm, throws the apparatus out of gear at the first passage of the current.

The electro-magnetic mechanism makes the automatic apparatus advance by means of a little toothed wheel moved by gearing arranged for the purpose. The teeth of this wheel work in the holes in the middle of the perforated strip of paper, and make it advance one hole at a time. If the automatic apparatus does not establish the current in the distributor, the telegraphic apparatus cannot work, and consequently cannot make the band of paper advance, so that any omission of a signal becomes impossible. For working by hand there is a key-board with 28 keys, each of which being furnished with two contacts, establishes the communication required in the distributor for the printing of the signal struck upon the key. There is, besides, a commutator for establishing the circuit of transmission or reception, and a little electro-magnetic apparatus for interrupting, which serves at the same time for an alarum. The little manipulator, which acts as an interrupter, serves also to send the current of the corresponding terminal to earth, an operation necessary for the regulation of the apparatus.

The current of transmission and reception acts in a manner precisely similar to that of the Hughes apparatus. After having served at the starting point to throw out of gear the transmitting apparatus, the current passes into the line and is maintained there during the entire revolution of the free printing axle. The ratio of the free printing axle to the type wheel being as 1 to 7, as has been already said, the duration of the current in the line will be $\frac{1}{14}$th of a second, at 120 revolutions per minute of the type wheel, a duration exactly equal to that of the Hughes apparatus under the same conditions of speed. The line current, after having effected the disengagement of the receiving apparatus, goes to earth, and by a special arrangement the distributor of the transmitting apparatus remains insulated while the current is in the line.*

An entirely indispensable part of this system is the perforation of the strip of paper, which serves for the automatic transmission of the despatches.

This apparatus, fig. 4, is provided with 28 piston keys, each of which makes when pressed down the two holes required by the combination of signals, and one hole in the middle of the strip to make the perforated paper advance, all three being in one single row. This apparatus could be worked with 8 keys only, but that would necessitate learning the combinations which form the signals in order to compose the despatches, and it would be necessary to press two keys each time. By the arrangement adopted of 28 keys, this inconvenience is avoided, and composition being thus simplified becomes sure and rapid.

Since there is necessarily between one letter and another a fixed and invariable distance, we can always, by simply measuring the strip of perforated paper, find at once and quite accurately the number of letters or signals presented for transmission, and charge for the messages accordingly.

We may remark that this apparatus constitutes one of the most ingenious pieces of telegraphic mechanism we have yet seen.

LEGISLATION FOR CABLE PROPERTY.

THE following is a copy of a circular letter which has been forwarded to the various Cable Companies by Mr. Lewis Wells, the Secretary of the Submarine Cables Trust:—

66, Old Broad Street,
March 22nd, 1882.

DEAR SIR,—Referring to the letter of the Board of Trade, dated 20th ult., of which you were furnished with a copy, asking to be supplied with "a map showing the position of the present telegraph cables," may I trouble you to send me, *as early as possible*, charts showing on a small scale your main system, and on a large scale the shore-ends and shallow water portions of your cables where they are liable to damage from ships' anchors and trawls.

The charts published by the Admiralty are the best adapted to this purpose.

When the charts are received from the several companies they will be arranged and forwarded to the Board of Trade.

It is expected that the measures now taken will lead to the cables being marked on the Government charts. Yours truly,

(Signed) LEWIS WELLS.

In this letter, emanating from the offices of the Eastern Telegraph Company, it will be noticed that this self-selected mouth-piece of the companies advises in a paternal manner the particular kind of charts which will best suit its purpose; we think that the companies addressed would be better able to judge for themselves the best means for conveying the information they are desired to supply to the Admiralty.

In our issue of January the 7th, we called attention to contradictory statements in Mr. Lewis Wells' previous letter, and again in that published above we notice an admission in direct contradiction to what has been on another occasion put forward by the individuals which that gentleman represents. We pointed out in THE ELECTRICAL REVIEW of February 18th, that "*As a matter of fact the Admiralty charts bear few tracks of cables*," and that "*in most cases these tracks are only approximately correct.*" Turning to paragraph 2 of the letter published in the same issue of this journal, and which emanated also from 66, Old Broad Street, the following will be found:—"That vessels should be directed not to anchor within—say, one mile of the line of a submarine cable *as laid down by the charts*," &c., &c.

Now Mr. Wells asks that this information should be added to the very charts which were previously said to contain it. Mr. Wells should really try to be more consistent.

THE ELECTRIC LIGHTING CONTRACT AND MAINTENANCE COMPANY, LIMITED.

THE prospectus of this company lies before us, and in it we perceive a determination to supply a want which it has been apparent to us would ere long manifest itself, namely, that of capital sufficient for the carrying out of contracts for lighting on a large scale. For whilst electric lighting is only worked in a small way it will have to struggle, perhaps vainly, in competition with its rival gas, which, notwithstanding its inherent defects, has the great advantage of being first in the field, with its positions thoroughly marked out and occupied, and also with its price calculated in accordance with a supply which is, in the case of the majority of gas companies, simply enormous.

For electric light companies (whose capital is mainly required in the purchase of patents and for the manufacture of apparatus), to do this would be impossible, unless fresh powers to raise additional capital were first obtained. Some such company as that now promoted was certain, therefore, sooner or later to be brought forward, and we hail its appearance with considerable satisfaction.

The capital is stated at £2,003,000 in 200,000 A shares of £10 each, with power to increase, and 300 B shares of £10 each, fully paid up. The first issue will be 100,000 of the A shares and the 300 B shares. The A shares will be entitled to a preferential dividend of 6 per cent. per annum, and the B shares will be entitled to one-third of the surplus profits after the payment of the dividend of 6 per cent. on the A shares.

We presume the 6 per cent. on the A shares is *not* cumulative, as there is no statement to that effect in the prospectus.

The 300 B shares are to be allotted to the directors for their "promotion" of the company.

It is stated that "the essential principle upon which this company proposes to act, and upon which the directors have based their expectations of success, is their *perfect freedom* (the italics are ours) to adopt all or any of the numerous patents for lighting now or hereafter to be brought before the public. They will have no object in working any one system in preference to another, but will

* The amount of work obtained from the telegraphic apparatus varies, according to the number of alphabets adopted, from 25,000 to 40,000 letters per hour. With three alphabets the result is about 27,000 letters per hour through a length of line equal to that over which the Hughes apparatus will work.

be guided in their selections solely by considerations of convenience, cost, and suitability." This reads very well, but when we perceive the well-known name of Colonel Gouraud in the list of directors, we can but think that the perfect freedom above alluded to almost presupposes that this gentleman is more than mortal. However, there is no system at present more thoroughly perfected or adapted for general purposes than that of Mr. Edison, and if the independence of the company is invaded in favour of this system, perhaps little harm will result.

With this slight exception, we see no reason why the company should not do good work, and obtain a profitable return on their capital.

CORRESPONDENCE.

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

Correspondence should arrive not later than Tuesday morning if it is desired to appear in the following number.

THE SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.

To the Editor of The Electrical Review.

Sir,—Will you kindly inform me the conditions on which "Associates" are accepted by the Society of Telegraph Engineers and Electricians, and the benefit which is likely to accrue to such Associates residing in the provinces and unable to attend the meetings of the society?

Yours truly,
INQUIRER.

["Inquirer" must apply to the Secretary of the society at 4, Broad Sanctuary, Westminster, S.W., for a "form," in which all the necessary information as to conditions will be found. The benefits derived by Associates residing in the provinces are almost identical with those residing in London, the only difference being that the latter can, if they choose, *be present* and hear papers read and see any experiments. The full reports of the proceedings of the society are sent to country members as to town members.—Ed. Elec. Rev.]

ELECTRICAL UNITS, &c.

To the Editor of The Electrical Review.

Sir,—The beauty and value of a popular lecture or of a popular work on any scientific subject is that it gives the hearers or readers a clear conception of the facts or principles adduced.

I heartily agree with the reviewer of Mr. S. P. Thompson's excellent elementary lessons on "Electricity and Magnetism," when he criticises somewhat adversely the explanations given of the units of length, mass, and time (L. M. T.) (C. G. S.), but more particularly when he explains the value of the ohm in relation to absolute units.

As your reviewer very clearly states, what beginners want is not somewhat difficult equations, but a clear numerical illustration of units, and specially clear illustrations of what is meant by volts, ohms, webers, ampères, &c., with the relations existing between webers and ampères, which at present appear in a condition of flux, and are almost used interchangeably.

If Mr. Thompson, or any other electrician familiarly acquainted with the units and relations referred to, would supply popular numerical illustrations of the same, it would tend to remove much of the obscurity that now obtains in reference to the precise meanings of the terms now in general use.

I trust that numerical descriptions of volts, ohms, webers, ampères, and other units of measurement, may shortly appear in your pages.

Permit me also to refer to what appears to be an unfair comparison between gas and electricity which has crept in towards the conclusion of your article in last week's Review on "Electric Lighting for Streets."

The writer states that "electric light has one great advantage as compared with gas which we do not think has been touched upon when speaking of both." He then proceeds to show that the increase of illumination given by gas is in exact proportion to the quantity of gas consumed: thus 5 feet gives 15 candles, 15 feet gives 45 candles. This statement is not quite accurate, as large burners are more economical than are small burners. Siemens' regenerative burner, for example, which consumes 30 feet of gas per hour, gives 4 candles per foot of gas consumed, and his lamp which consumes 100 cubic feet of gas per hour yields 10 candle-light per foot. The electrical illustration is very erroneous. 0·5 ampères gives no light; 1·0 ampères yields 2 candle-light; 1·5 ampères gives 35 candles. Showing not a rapid increase of illuminating power, but merely the fact that for illuminating purposes the first ampère is practically wasted, good light being only obtained when the free electromotive force equals 1·5 ampères. There is not any "enormous increase" in doubling the electric current from ·5 to 1·0; it is merely from 1·0 to 1·5 that the increase takes place, and it is practically limited to 35 candles, as if raised to higher intensity the lamps would be speedily destroyed, and even at 35 candles the illumination is dangerous to the carbons.

The great defect of all incandescent carbon lamps is their inability to bear high incandescence. It is dangerous to the carbons to raise any of them to 30 candles, it is speedily destructive to increase them to 50 candles, and in this fact is one of the present weaknesses of incandescent lighting, as one horse-power will give about 2,000 candles by arc light, but not with safety more than 150 candles by incandescent illumination.

I am, &c.,
T. P. BARKAS.

Newcastle-on-Tyne,
March 26th, 1882.

[Regarding the latter part of our correspondent's letter, we may say that the Siemens regenerative gas-burner was not considered at the moment, but the more usual method of increasing street lighting by using two or three ordinary gas-burners in the same lamp. Mr. Barkas starts to refute our argument, with a gas lamp giving a light of 120 candles, and finishes by quoting another giving 1,000 candle-power. To compare these large lamps with the electric light we should be obliged to fall back upon the arc system, whereas we were speaking of the moderate light obtained by electric incandescence and working up to 50 candle-power. We quite believe that gas lighting is capable of great improvement, and that eventually we shall have more than double the light for double the consumption of gas, but that at present, for the purpose we were considering, our remarks hold good. We do not understand our correspondent's meaning when he talks about a "free electromotive force equal to 1·5 ampères."—Ed. Elec. Rev.]

THE ACTION OF THE TELEPHONE.

To the Editor of The Electrical Review.

Sir,—Though a discussion in one's own name with an anonymous correspondent is seldom satisfactory, the tone of "Telephone's" letter indicates that it is not necessary to apply that rule to him; I therefore ask him to be good enough to tell me how to "send through the primary coil a current whose strength continually and uniformly diminishes or increases." I mean how to send through the primary coil a current which is clearly, unmistakably, and indisputably that which Bell describes as an undulatory current, and which is not a mere series of impulses. I have carefully watched the effect of the current of a Bell telephone, used as a generator, in a very sensitive reflecting galvanometer and, in my judgment, the effect in the galvanometer is produced by a series of impulses, and that there is not a continuous current.

In the second paragraph of his letter "Telephone" admits the existence in the alleged undulatory current of "a point where there is no potential, *i.e.*, where no current flows." Let me ask in what respect is this different from a break?

I fail to realise the analogy in the last paragraph of "Telephone's" letter, and should be glad to learn how a current of electricity can pursue "a sinuous course" along a wire ·005 of an inch, or less in diameter.

I am, Sir, your obedient servant,

H. B. T. STRANGWAYS.

5, Pump Court, Temple, E.C.,
March 28th, 1882.

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.—MARCH 25th.

Prof. CLIFTON, President, in the Chair.

New Members—Mr. M. J. JACKSON, B.A.; Mr. NAZARUS FLETCHER, British Museum.

MR. SHELFORD BIDWELL read a paper on "The Electric Resistance of a Mixture of Sulphur and Carbon." These experiments were begun in December, 1880, to ascertain if the mixture in question was sensitive to light like selenium. Sulphur was melted and mixed with powdered plumbago, (the best proportions being 20 parts by weight of the sulphur to 9 parts of the plumbago). The mixture was poured into moulds and quickly cooled, yielding plates and sticks. When exposed to the light of a gas flame, an increase in resistance was noticed, and was proved to be due to the heat of the flame, not the light, by experimenting with different sources of light and coloured screens of glass. As both carbon and sulphur decrease in resistance under heating, this opposite effect of the mixture is anomalous, and Mr. BIDWELL explains it by supposing that the mixture is mechanical, and that heat, expanding the size of the insulating sulphur crystals, separates the conducting carbon particles further apart, and increases the resistance of the mass. Cells of this compound were made like selenium cells, by spreading it between the parallel turns of fine platinum wire round a mica plate, and the rise of resistance for temperature carefully measured. At 14° C. the resistance was 9,100 ohms, at 55° C. it was 5,700 ohms, and the rise was in greater ratio than the rise of temperature. Mr. BIDWELL also found that these cells would transmit speech when connected in the circuit of a battery and a Bell telephone. They also acted as a thermoscope when employed after the manner of a thermopile. Mixtures of shellac and graphite, of paraffine and graphite, &c., were also tried with like results.

In reply to Prof. MACLEOD, Mr. BIDWELL said the resistance of the cells decreased soon after being made. Mr. BIDWELL also stated that acting on a suggestion of Dr. Hopkinson, he had found that the resistance diminished under a more powerful current.

Mr. C. V. BOYS read a paper on "A New Method of finding the Index of Refraction of Lenses," based on the general principle employed by Foucault, of causing a ray of light to return on the same path.

Prof. CLIFTON stated that a similar method was now employed by him at Oxford, and answered well for small lenses.

Prof. FITZGERALD, of Dublin, showed mathematically that it was impossible for a small charge of static electricity, carried along by the earth, to move a magnet in the neighbourhood.

Prof. AYRTON questioned this conclusion and exhibited an apparatus intended to test the point experimentally.

The meeting was then adjourned till April 22nd.

THE SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.

AN ordinary general meeting of this society was held on Thursday, March 23rd, Lieut.-Col. WEBBER, R.E., President, in the chair. The minutes of the last ordinary general meeting having been read and confirmed, and the list of proposed new members read, a paper was read by Professor A. E. DOLBEAR, on "The Development of a New Telephonic System."

The first known experiment in which an attempt was made to produce musical sound by electrical means appears to have been that of Page, in 1837. The arrangement consisted of an iron bar surrounded by a wire coil; when intermittent currents of electricity were sent through the wire coil a lengthening and contraction of the bar took place at each make and break, this change producing a "tick;" when the makes and breaks followed one another with rapidity the ticks produced a musical sound. These makes and breaks were not made automatically.

The next instruments appear to have been made by Farmer; his apparatus consisted of an electro-magnet fixed on one side and within a wooden box, an armature being placed opposite the poles of the magnet and fixed on the opposite side of the box. When an electric current was sent through the electro-magnet the side of the box on which the armature was fixed was drawn towards the magnet, and if a series of makes and breaks took place rapidly the box gave out a musical sound. Farmer used as a transmitting apparatus a number of harmonium reeds with contacts fixed to them. He thought that he might be able to transmit articulate speech with his apparatus, but failed in his attempts. Subsequent work on the electrical transmission of musical sounds was done by Helmholtz, who used tuning forks. Reiss then followed with his well-known apparatus; he undertook to transmit articulate speech. The problem that was required to be solved was that of producing *variation* of the electric current; this, Professor DOLBEAR said, Reiss evidently intended to produce with his apparatus, since at that time the possibility of effecting variation must have been understood, from the simple fact that in making up batteries, &c., it was known to be necessary to screw up all connections quite tight, otherwise the passage of the current became obstructed.

The original apparatus of Reiss was made in 1863 by Albert, but Reiss did not confine himself to that particular form; he made numerous experiments with various modifications of the original form, these were all exhibited in the recent Electrical Exhibition at Paris. Professor DOLBEAR drew particular attention to a form of the Reiss instrument in which the box was of a shallow form. The receiver which Reiss invented was that of Page, mounted on a sounding board. Will this receiving apparatus of Reiss produce articulate speech? As the apparatus will respond to varying currents, it possesses all the essential elements for producing speech, though the effects are very meagre. Reiss evidently expected, or aimed at the apparatus speaking out quite loud; this no apparatus existing at the present day will do. Reiss in 1863 tried another receiver beside that of Page, formed of an armature set at the end of an electro-magnet. It is curious that very little serious attention has been paid to the later apparatus of Reiss. Professor DOLBEAR considered that Reiss had invented a transmitter that would vary the current, and a receiver that would produce articulate speech, *i.e.*, he had produced a complete telephone system. In 1876 Professor Bell brought out a new system, quite distinct from that of Reis. This invention was the first in which it was proposed to speak to the armature of an electro-magnet; an improvement on the first arrangement was the substitution of permanent for electro-magnets. This was done by Professor DOLBEAR in 1876. The action of the magnetic telephone when used as a transmitter was too feeble for practical purposes, and it was soon seen that some form of apparatus was necessary by which the current could be varied. Attention was therefore turned to Reiss's apparatus, to see whether it could be made more efficient. It was soon found that the platinum contacts would not work properly, as they were liable to become fused together. Edison proposed the use of lamp-black carbon, and he thought that the action was to compress the latter. Professor Hughes showed that hard carbon was equally efficient. If this latter substance is substituted in the place of the platinum in Reiss's apparatus we have a perfect transmitter. Various properties of the electric current, such as chemical action, heating effect, have been employed for actuating the transmitter. In the electro-motograph of Edison the chemical effect is made use of. An arrangement somewhat similar to that of Edison had been tried by Professor DOLBEAR; it consisted of an iron cylinder on the periphery

of which rested a small horse-shoe magnet fixed to a diaphragm: a coil of wire surrounded the iron cylinder. When the latter was rotated, the horse-shoe magnet, by clinging to it, became drawn forward and kept the diaphragm in a state of tension, as in the electro-motograph; when a current of electricity was sent through the coil of wire, the iron became magnetic and reduced the friction between the horse-shoe and the iron, thus allowing the diaphragm to spring back, the amount of this depending upon the strength of the current. This apparatus was called a "rotophone."

Prof. Dolbear then showed that an ordinary sounder or relay, if it had a proper ear-piece attached to it, would be found to answer as a receiver. For some time it had been known that a Leyden jar when charged or discharged gave out sounds, and in 1863 Sir William Thomson had noticed a similar effect in an air condenser. Subsequently Dr. Wright, by placing two pieces of paper silvered on one side only, back to back, and connecting the sheets to an induction coil, the primary of which was in the circuit of a Reiss transmitter, obtained musical sounds. Varley, later on, made similar experiments with larger condensers formed of loose sheets of tin-foil. As regards his own (Prof. Dolbear's) apparatus, he would mention that he was not led up to the idea as the result of the foregoing experiments. He had attempted to make a receiver of two plates, between which various liquids were placed. He anticipated that the instrument so made would respond from the disengagement of gas on the plates, and this proved to be the case. Having experimented on one occasion with a receiver of the foregoing description, which had become emptied of its contents through leakage, he found that the instrument still responded perfectly. Prof. Dolbear then described the general principle on which his receiver worked, and he remarked that the principle of the attraction of electricity through a space was a very important one, and deserved to be more carefully studied than it had yet been. He had tried plates of various dimensions for his receiver, and had found that a size of about 3 inches gave the best effect. With reference to Herz's "singing condenser," he said that no advantage was gained by multiplying the number of the plates, in fact, there would be a loss of effect by doing so. The principle of the instrument he considered to be wrong. The best effect was produced in the Dolbear receiver by a high tension current, and he had used as a transmitter to vary such a current two points close together, whose distance was varied, so that the air space offered more or less resistance to the passage of a spark. He found that a resistance of 3,000 ohms for the secondary wire of the induction coil gave the best effect. The resistance through which the receiver would work was enormous; he showed that it would even work when there was discontinuity in the circuit, that is, when the receiver was simply held near the end of the line wire, even a distance of 50 ft. between the two did not entirely extinguish the sound. It was not necessary to put the second plate of the receiver to earth, though the effect was louder. In the latter case the instrument would even speak with the second plate made of ebonite, this plate being excited by slight friction to electrify it. His apparatus had been worked through 256 miles of wire in very wet weather, and the effect was as good as in fine weather.

It was stated that the instrument was not affected by an amount of induction which would spoil the working of the ordinary telephone.

In the discussion which followed the reading of the paper

Mr. Willoughby Smith said that in the early part of the year he had himself been experimenting on induction, and he had found that if a spiral of wire was hung up in the middle of a room and intermittent currents were sent through the wire, that sounds could be distinctly heard in an ordinary telephone held closely to the ear in any part of the room.

Professor Adams said that in 1864 Mr. Yeates, of Dublin, had converted the Reiss transmitter into a variation instrument by placing a drop of water at the contact.

The President said that although five years had elapsed since Professor Bell had first introduced the telephone to the Society, but very little had been brought forward in the shape of papers on the subject. He would mention that a complete list of pamphlets and patent specifications would be found in the Society's library. The question of priority of invention was an interesting one, though it was not for the Society to decide it.

A vote of thanks having been proposed by Mr. Preece and seconded by Professor Foster, the meeting then adjourned.

NOTES.

Central and South American Cables.—Mr. E. W. Parsoné telegraphs from Salina Cruz, near Tehuantepec, Mexico, that during the survey made by the ss. *Retriever*, he has found an excellent bottom throughout from Chorillos, near Lima, Peru, to Salina Cruz, no rock being found north of Santa Elena, Ecuador. A 300 fathoms line is easily obtainable. The soundings at the various landings are not quite complete, but Mr. Parsoné intends completing them on his way south to Panama. The *Retriever* left Salina Cruz on the 28th inst.

Anglo-American Telegraph Company.—The Brest-St. Pierre section of this company was interrupted on the 20th inst., and we understand that the break is on the American side, in fairly deep water. It is expected that this company's repairing vessel, *Minia*, will undertake the repairs.

The Greetsiel-Valentia Cable.—The Telegraph Construction and Maintenance Company's ss. *Scotia*, 4,667 tons gross, passed down the river on the 27th, to complete the laying of the Greetsiel-Valentia cable. It is to be hoped that during the operation the *Scotia* will not be so unfortunate as to break and lose part of the cable, as grappling in the neighbourhood of the 19 already existing cables which she crosses in the performance of her duties would be a very dangerous and undesirable feature.

The International Exhibition of Electricity, Paris, 1881.—A final meeting of British exhibitors and subscribers to their guarantee fund was held on the 23rd ultimo, in the library of the Society of Telegraph Engineers and of Electricians, fourteen gentlemen being present. The balance-sheet showed that £1,131 6s. was guaranteed; of this 12s. 6d. in the pound was called up, which amounts to £707 1s. 3d., less £5 13s. 9d. unpaid by guarantors, and plus £15 received as donations, which with £1 2s. interest added, gives a total of £717 9s. 6d. The expenditure in England amounted to £26 19s. 1d., and in Paris (deducting amount realised on sale of plant, 906 fr.) to £449 0s. 2d. Total expenses £475 19s. 3d., which leaves a credit balance of £241 10s. 3d. Of this sum £50 was voted to Mr. Aylmer, and £25 out of pocket expenses to the same gentleman; £50 to Mr. F. H. Webb, and the balance, it was resolved, should be applied to the formation of a fund, the interest on which is to furnish a prize, to be awarded yearly, for the best paper on an electrical subject presented to the Society.

The Electric Light in America.—Preliminary arrangements have been made for lighting the avenues and parks of Washington city by arc lights, the generators to be located at the Great Falls of the Potomac, twenty-three and a half miles above the city. It is proposed to conduct the electricity in Lugo's solenoidal cables, and to have several independent generators run by turbines, and thus avoid a probability of failure of any one. These falls afford ample power for lighting, manufacturing, and all other purposes, there existing at low water a minimum of 25,000 horse-power.

The Little Falls, four and a half miles above the city, are also deemed available, and may be used instead. They furnish 27 feet fall, and 2,000 horse-power at low water.

Dr. Lugo guarantees to furnish light to the amount of 100,000 candles at reduced rates, and more than double the amount now furnished by the gas companies.

Dr. Lugo's Solenoidal Cables.—The Common Council of the city of Philadelphia have ordered all wires conducting electric circuits, telephonic, telegraphic, light, &c.,

within the city limits, to be placed under ground in the Lugo solenoidal cables. A successful test was made by Dr. Lugo before the leading business men, including many distinguished gentlemen from New York city, by which he demonstrated clearly and to the satisfaction of all the feasibility of his anti-induction solenoidal system. In this test telephones were included in the solenoidal conductors, and light circuits were run adjacent thereto, and not a sound could be heard due to the light circuits; while in the ordinary insulated earth circuit cable, even the Morse instruments could be clearly heard on circuits over 40 ft. distant. The Doctor says that his system is the most desirable light circuit extant, inasmuch as it acts as a large condenser, and compensates by back discharge for any inequalities in the speed of the generator, or fluctuations of current due to changes in the lights in the circuit. It appears to act as a delicate balance, so sensitive, that the least variation in the circuit readily compensates itself.

THE TELEPHONE AT DUNDEE.—Our Dundee correspondent informs us that "the National Telephone Company's branch at Dundee, after two years' existence, being seemingly hopeless of obtaining subscribers, has intimated to all the renters of a successful local company that they will give them wires and instruments for nothing during the currency of their existing leases, and then afterwards at the rate of £5 yearly. The local telephone company charge £10 yearly, and have 200 subscribers on their exchange."

THE HEISLER ELECTRIC LIGHT AT WASHINGTON.—The Heisler Light Company has made contracts to light F. Street from their central station at the Daily Post Building, and will proceed at once to put in the lights between the Patent Office and Treasury Department.

GAS *v.* ELECTRIC LIGHT AT DUNDEE.—Our Dundee correspondent writes:—"The Dundee Gas Commissioners have at present a bill before Parliament, asking exclusive power to prevent any company from furnishing electric light to works, factories, shops, &c., in that town. In anticipation of this being granted, they have privately obtained a hire of a three-light apparatus, and are experimenting, so that they may master all the details of electric light engineering within themselves, and astonish the town with the results."

AMERICAN IMPROVEMENTS IN RAPID TELEGRAPHY.—A most remarkable and ingenious invention in rapid telegraphic relays has recently been patented in America to Mr. Gerritt Smith, which effectually overcomes all difficulties due to long lines. This relay is constructed upon the principle that the armature need only make partial strokes between the breaks due to the dashes and dots in the Morse system. An ordinary electro-magnet is placed in line circuit, whose core is adapted or caused to rotate by suitable mechanism. On the free end of this core, opposite the mechanism which rotates, it bears one end of a pivoted armature, whose outer end plays between contact points of a local circuit in the ordinary manner, and is provided with a well-known form of retractile spring, which tends to rotate the end bearing on the revolving core in a direction opposite that of said rotating core. When a current is set up in the electro-magnet, the armature is drawn down against the smooth face of the revolving core, and carried forward until the local circuit is closed through it and the local contact points. If a series of dots are made, the armature falls back, but never during the series falls entirely back on its back stop. On this instrument Mr. Smith has been able to receive accurately, over 600 miles of line wire, 2,000 words per minute, and a perfect and accurate record is made on an automatic register in the local circuit. Mr. F. S. Pope, of New York city, assures us that there is now no doubt about the success of automatic systems over 1,000 mile circuits with this relay. If this is true, there will be a wonderful revolution in telegraphic systems dependent upon skilled Morse operators, and indeed that will become very soon a useless element in telegraphic business. These instruments will doubtless be used extensively in England, where automatic telegraphy seems already to be in the ascendency, at least so thinks our American correspondent.

MINERALS, CHEMICALS, &C.—We extract the following from George G. Blackwell's report. Liverpool, March 24. Minerals: Our market has remained firm during the week. Iron ore: Antrim, No. 1, 12s.; No. 2, 10s. 6d. to 11s.; Cumberland, 7s.; Devonshire, 13s. 6d. to 14s.; Campanil, 9s. f.o.b.; Porman, manganiferous, 14s. Purple ore, 14s. Barytes: carbonate and sulphate are both in good demand, especially the "Standard" brands. Carbonate: best lump, 87s. 6d. to 90s.; seconds, 75s.; common, 60s.; finely ground, £6 to £7 10s. Sulphate: selected lumps, 42s. 6d. to 45s.; first class, 27s. 6d.; good, 18s. to 20s.; prime white ground, 85s. to 87s. 6d.; first class, 72s. 6d.; seconds, 55s.; common, 47s. 6d. China clay: best, 42s. 6d.; good, 35s.; fair, 22s. 6d. Emerystone: price continues firm at £6 5s. French chalk: the arrivals this week amount to 430 bags, and price remains steady at £5 10s. to £5 15s. Asbestos: floss, £24; Canadian rock, £32; common, £17 to £18. Phosphate of lime, 1s. 5d. per unit. Tungsten metal, 3s. 6d. per lb. Magnesite (containing 98 per cent. of carbonate of magnesia) remains firm at 65s. to 70s. to arrive. Bog iron ore, 27s. 6d. Carbonate of strontia: best, £18; good, £10. Manganese ore remains unchanged. Ferro-manganese: 50 per cent., £13 10s. to £14; 70 per cent., £22. Antimony ore: best £18; crude of high percentage, £24. Plumbago: best, £18; good, £7 10s. to £8. Pyrites, iron and cupreous, 6d. per unit. Resin: good medium, £8. Chemicals have been rather quiet this week. Soda ash, 15-16d. to 19-16d.; caustic soda, 60 per cent. white, £8 10s. to £8 12s. 6d.; cream, £8 5s. to £9 7s. 6d.; 70 per cent. white, £9 12s. 6d. to £9 15s.; bicarbonate, £9 2s. 6d. Chlorate of potash, 6d. per lb. Bichromate, 6d. Soda crystals, £3 10s. Sulphur: roll, £8 17s. 6d.; flour, £11 15s. Copperas, 45s.; in bulk at the works, 22s. 6d. Sulphate of copper, £21. Metallic sodium, 7s. 6d. per lb. Chloride of calcium, 60s. Metallic cadmium, 7s. 9d. per lb. Chloride of barium, 1s. 6d. per lb. Chlorate of soda, 1s. 3d. per lb. Nitrate of strontia, 52s. Tungstate of soda firm at 90s. Blanc fix, £9. Nitrate of baryta, for chemical purposes, 31s. 6d.; best refined, 32s. 6d.; double refined, 35s. Carbonate of magnesia, 51s. 6d. Manganese: sulphate, £21. Borate, 10d. to 1s. per lb. Chloride, £24. Acetate scarce. Nickel salts for plating, 2s. per lb. Salammoniac, best, 46s.; seconds, 45s. Muriate of ammonia: white, 33s.; grey, 31s. Sulphate of alumina, £6. Muriate of potash, £9 10s. Kieserite, 60s. Kainite, 32s. 6d. Hydrate of alumina, £21. Nitrate of soda, 15s. Montreal potashes, 29s. 6d. Shellac: best orange, £10; good, £9. Carbonate of potash, 29s. 3d. Verdigris, 10d. to 1s. per lb.

FIRE TELEGRAPHS IN BALTIMORE.—Mr. C. F. McCulloh, of Baltimore, has introduced a much needed device into use in Baltimore for fire telegraph systems, which obviates all liabilities of any box on any circuit being thrown out of circuit by a break of the line wire. Each circuit of the fire alarm system is normally closed through an independent battery and relay system at the central station, which controls a local circuit operating a gong and register. A break or a ground at any point is announced by the gong, and an operator at the central station manipulates a switch in such a manner as to ground the circuit through relays on either side of a main central station battery, said relays being provided with front and back contacts and switch plugs, which operate to close a local circuit to the signalling gong and register. Each signalling box puts on a local ground when it operates, and signals in a direction opposite to the break. No box can ever be left out of circuit unless by the improbable event of a double break, one on each side of it. The Baltimore Fire Department has adopted Mr. McCulloh's system, and expresses eminent satisfaction as to its operativeness and security.

THE GOVERNMENT ELECTRIC LIGHT BILL.—Considerable curiosity prevails throughout the country as to the intentions of the Government with relation to the various Electric Light Bills now before Parliament. An inaccurate statement having been put in circulation concerning the Electric Light Bill which is shortly to be introduced by the President of the Board of Trade, it may dissipate some groundless alarm if we briefly explain the nature of the provisions of that measure. The Bill, which has been prepared after a careful

consideration of the whole subject, in which the opinions both of the electric light companies and the municipal corporations have been fully heard, is a simple permissive measure, intended to facilitate the extension of the new mode of public and domestic illumination. Its first provision will authorise any corporation, company, or private individual to apply, with the consent of the local authority, to the Board of Trade for a licence to supply electric light for a period of five years. The licence will contain provisions to prevent undue preference and to protect the public from danger. Where the consent of the local authority is refused, or where the applicants wish for a longer period than the experimental term of five years, it is provided that the application must be for a provisional order, subject to the assent of Parliament, and going to a Select Committee if it be opposed. The provisional order will give powers for an indefinite time, but it will contain clauses similar to those in the Tramway Acts giving the local authority the power to purchase at stated periods without paying for compulsory sale or prospective profits. The whole subject is in so purely an experimental stage that the primary object of the measure is to give full facilities for such experiments, and to throw no obstacle in the way of the extension and development of scientific discovery, while at the same time making provision against the creation of another monopoly, such as that of the gas and water companies, which might subsequently have to be bought up at a great loss to the community. Some municipal corporations have applied to have the exclusive right of supply and sale of electricity for lighting purposes: this claim has been regarded as inadmissible on two grounds. In the first place, the authorities in question, after obtaining the power to supply might refuse to use it, and so exclude the district under their control from all the benefits of a new discovery; and secondly, even if they undertook the supply they could not at the present time agree to the conditions which are always insisted on when similar monopolies are granted in the case of gas—namely, the obligation to supply any one in the district who demands it at a fixed maximum price and a fixed minimum quality. No corporation in the present stage of electric lighting could agree to a similar provision as to the supply of electricity. The limitation of the duration of a licence to the comparatively short term of five years keeps the subject open for reconsideration, and will enable the Legislature to deal with the question and make whatever changes may be necessitated by the progress of electrical science without being embarrassed by a host of troublesome vested interests.—*Pall Mall Gazette.*

Gas Companies and the Electric Light.—There are many very significant facts daily occurring to show that the gas companies no longer look upon the electric light as a rival beneath their notice. Some of them are even giving proofs that it is a matter well worthy their most earnest attention, and one which, if they have a true perception of their interest, it behoves them to turn to account. In support of this we hear from our Paris correspondent that several of the French gas companies have formed a syndicate and subscribed the necessary funds to institute on their own behalf most exhaustive experiments with the electric light. For this purpose they have fitted up a laboratory in the vicinity of the Porte Maillot, and stocked it with every requisite machine and apparatus to enable complete tests to be taken of all electric lights and the actual power taken up by each system, and which will of necessity lead to correct appreciation of the relative cost of each inventor's method of producing light. This laboratory, which is most complete in its fittings, is placed under the charge of Monsieur Monnier, who has all the needful qualifications for carrying out the necessary experiments and reporting to the gas companies. We cannot but compliment these companies upon the good sense they show in thus taking seriously in hand an invention which superficially thinking people might believe to threaten their interests, but which we feel sure will be found to be an adjunct, and a most valuable one, rather than a rival to gas; for we hold that electric lighting is no more destined to suppress the use of gas, than the introduction of railways has stopped the breeding of horses. Quite on the contrary, the one will develop the other.

Cable from Spain to the Canary Islands.—The Spanish Government has officially published the conditions under which it will grant an exclusive concession for this line, and at the same time invite the sending in of propositions as to the lowest subsidy upon which the enterprise will be undertaken.

The main cable extends from Cadiz to the northern part of the island of Teneriffe: the direct distance is estimated at 700 knots. There are to be three branch or minor cables, to serve as feeders to the principal one: the first will be from Teneriffe to the island of La Palma, distant some 55 knots; another will be laid from Teneriffe to Canary Island, 46 knots distant; and the third will be from Canary Island to Lancerota Island, and have a length of 96 knots. This makes a total of 897 knots, and unites all the principal islands of the group with the mother country.

The conductor of these cables is to be a 7-stranded copper wire weighing 107 lbs. to the knot, and insulated with three or four coatings of gutta-percha weighing 140 lbs. per knot. The copper resistance is not to exceed 12 ohms, and the insulation resistance is not to be less than 250 megohms per knot. The sheathing will consist of two layers of tanned Manilla hemp covered over with nine homogeneous galvanised iron wires, each 2·15 mm. diameter, laid on with alternate strands of hemp. In the shore ends the diameter of the nine iron wires will be increased to 9 mm.; and should the special conditions of the landing place require it, there will be a second protection of iron wires laid on.

The contractor is to lay and work the cables and fit up the necessary stations, and the whole is to be completed within six months from signing. The concession is for ten years, after which the whole property reverts to the Spanish Government.

Electric Lighting Contract and Maintenance Company, Limited.—Capital: £2,003,000 in £10 shares. Registered Office, 6, Lombard Street, E.C. Objects: To generate, manufacture, produce, store, accumulate and supply electricity or electromotive power, or similar agency, for lighting, heating, and other purposes. Signatories (with one share each):—*A. G. Sandeman, 20, St. Swithin's Lane; *Stewart Pixley, 27, Old Broad Street; *W. H. Maudsley, Westminster Road, Lambeth; *G. E. Gouraud, 6, Lombard Street; *G. Norman, 19, Chester Square; *J. C. F. Lee, Beckenham; and J. F. R. Farquar, 18, King Street, St. James's. The first six signatories and Messrs. Martin Ridley Smith and Stamford Sheridan are the first directors. Qualification, 100 shares; remuneration, £3,000 per annum. Registered 24th ult. by Dawes and Son, 9, Angel Court, Throgmorton Street.

The Electric Exhibition.—The directors of the Crystal Palace have appointed the following 21 British jurymen:—Captain F. W. Abney, R.E., F.R.S., Professor W. Grylls Adams, F.R.S., Major R. F. Armstrong, R.E., Professor W. E. Ayrton, F.R.S., Mr. Shelford Bidwell, Sir S. Canning, Professor R. B. Clifton, M.A., F.R.S., Mr. T. R. Crampton, C.E., Mr. Horace Darwin, Professor G. Carey Foster, F.R.S., Professor E. Frankland, F.R.S., Captain Douglas Galton, C.B., F.R.S., F.R.G.S., F.G.S., F.L.S., D.C.L., Lieutenant-Colonel W. Haywood, Dr. J. Hopkinson, F.R.S., Professor D. E. Hughes, F.R.S., Professor Fleeming Jenkin, F.R.S., S.L. and E., M.I.C.E., Professor J. W. Keats, Mr. W. H. Preece, F.R.S., Professor Silvanus Thompson, B.A., D.Sc., Mr. C. E. Spagnoletti, C.E., and Lieutenant-Colonel Webber, R.E., President Society of Telegraph Engineers. The first meeting of the British section of the jury was held at the Crystal Palace on Tuesday evening, when nearly all the jurymen were present. Some of the foreigners who have been asked to act on the jury have already accepted, and the names of the foreign jurymen will be announced as soon as the list is complete.

The ss. "Dacia."—Mr. W. F. King telegraphs from Lima, Peru, that this cable ship left Concepcion (Chili) in cargo and bound for England, on the 23rd inst. All well.

NEW PATENTS—1882.

1385. "An improved construction of electric contact making thermometer." J. FORMBY. Dated March 22.

1390. "Apparatus for driving, regulating, and indicating speed of dynamo machines used for lighting purposes, specially applicable for railway vehicles on or to which dynamos can be affixed for producing the current by the motion thereof." J. B. ROGERS. Dated March 22.

1392. "Improvements in incandescent electric lamps and in the preparation of carbons for the same." D. GRAHAM and H. J. SMITH. Dated March 22.

1400. "Incandescent electric lamps." T. E. GATEHOUSE. Dated March 23.

1405. "Improvements in electric gas-igniting apparatus, parts of which improvements are applicable to batteries for the generation of electric currents generally." J. W. URQUHART. Dated March 23.

1412. "Electric lighting and apparatus connected therewith." O. E. WOODHOUSE and F. L. RAWSON. Dated March 23.

1437. "A new or improved electric accumulator for the storage of electric energy." S. COHNE. Dated March 25.

1444. "Electric incandescent lighting apparatus." R. WERDERMANN. Dated March 25.

1455. "Secondary batteries for the storage of electricity." G. MOLLOY. Dated March 27.

1462. "Electric lamps." S. WATERS. Dated March 27.

1464. "Electric piles or batteries." F. DE LALANDE. (Partly communicated by G. Chaperon.) Dated March 27.

1465. "Carbons for electric lamps." A. SMITH. Dated March 27.

1483. "An improved coiling machine." C. L. CLARKE and J. LEIGH. Dated March 28.

1496. "Dynamo or magneto-electric machines for regulating the generative capacity of such machines." T. J. HANDFORD. (Communicated by T. A. Edison.) Dated March 28.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1881.

2635. "Floating apparatus for generating and conveying electricity for production of electric light and transmission of power." W. C. JOHNSON and S. E. PHILLIPS. Dated June 16. 2d. Relates to a floating apparatus for generating and conveying electricity and producing the electric light and other purposes, and consists of a special arrangement and combination of steam boilers, engines, and electric machines on board a suitable barge or vessel to receive them for the purpose of producing electricity and the electric light, or for the purpose of transmitting power by electricity, the object being to provide a source of obtaining and conveying an electric current or currents, which source as a whole is locomotive, and so may be easily moved from place to place, so that ships and other floating structures, constructions in progress in or near the water, and buildings and places at or near the water's edge, may be provided with the electric light, or power for working cranes, pumps, or for other purposes. Drums are fitted for coiling the cables for leading the currents where desired, and the whole apparatus can be readily towed to the required place, or it may be made self-propelling.—(*Provisional protection not allowed.*)

3283. "Electric generators." SYDNEY PITT. (A communication from abroad by Simeon J. M. Bear, of the United States of America.) Dated July 26. 8d. The general principle of the invention consists in so constructing, combining, and organising the armatures and field magnets of dynamo machines with reference to each other that the armatures or moving parts of the machine shall roll upon or revolve in contact with the surface of the field magnets or fixed portions of the machine, or *vice versâ*.

3301. "Apparatus for lighting gas by electricity." E. B. BURR. Dated July 28. 6d. Relates to improvements in apparatus for lighting gas by electricity. For this purpose there is employed a portable galvanic battery which is combined with a pole or holder having the ordinary gas torch attached thereto, in which the two poles of the battery are connected by any suitable substance which can be rendered sufficiently incandescent by the action of the electric current to ignite the gas. The galvanic battery is brought into and thrown out of action by a spring, or otherwise, under the control of the user.

3346. "Electrical signalling apparatus, &c." J. U. MACKENZIE. Dated August 2. 6d. In connection with messenger calls and fire-alarms, call boxes have been placed at different stations and connected by wires to a central office, and on moving a handle a call or alarm is given at the central station corresponding in its number to the instrument whose handle was moved. This system renders it necessary that each call box be adapted to send its own designated number, and hence the wheel or other device that makes and breaks the circuit is different in one box from those in all the others. If any one call box gets out of order another cannot be substituted unless especially prepared to transmit the certain number allowed to that station. The object of this improvement is to construct all the call boxes alike, and to allow each call box to be set to the desired number. Hence such call box can be used at any station to indicate the station number, or it can be used in connection with telephone lines to denote the number of the station or subscriber with which the caller desires to be connected at the central office or exchange; or the instrument can be used to denote what is desired in the messenger service by indicating one number after another according to a prearranged code, or by giving a certain set of electric pulsations upon the line for certain signal.

3349. "Electric lamps." A. W. L. REDDIE. (A communication from abroad by Denis Alexandre Chertemps, of Paris.) Dated August 2. 6d. Relates to a novel arrangement of electric lamp, the objects being to simplify its construction and to enable it to receive carbons of any desired length.

3362. "Electric lamps, &c." JOHN HOPKINSON. Dated August 3. 6d. Has reference partly to the mode of regulating the distance between the carbons. In carrying out the invention, one of the carbons is carried from the armature of an electro-magnet, not rigidly but in part, by means of a catch which can be liberated when the arc becomes too long, either by the action of the aforementioned armature which also starts the arc, or by the action of a special armature of another electro-magnet arranged expressly for the purpose. The carbon holder is also connected to the armature by means of fluid in a suitable receptacle in such wise that the relative motion of the carbon and armature is controlled and restrained by the viscosity of the fluid.

3384. "Electrically-actuated indicators, &c." J. C. MEWBURN. (A communication from abroad by Chester Henry Pond, of New York, America.) Dated August 4. 8d. Consists principally of certain improvements in the construction and operation of an electrical indicator described in a previous patent.

3386. "Electric organ." W. F. SCHMOELE and ALEXIS MOLS. Dated August 4. 8d. Relates to improvements in the application of electricity to organs, whereby they may be played by hand or automatically by specially designed sheets of music. The wind-pressure supplies the working power, and the electricity times and regulates its application.

3394. "Generating electric currents, &c." ST. GEORGE LANE FOX. Dated August 5. 6d. Has reference to means or apparatus for generating electric currents, and for producing motion by electricity.

3402. "Electric lamps and manufacture of carbons for same." J. H. JOHNSON. (A communication from abroad by Jean Baptiste Java Mignon and Stanislas Henri Rouart, both of Paris.) Dated August 5. 6d. Relates to improvements in the manufacture and mode of employing carbons or candles for electric lamps, in which the carbons are hollow and filled up either with another and smaller carbon of different composition, or with a substance differing from that of which the carbon proper is composed, introduced by any suitable means, so that a more steady and regular light is obtained than that produced by the employment of solid carbons.

3485. "Appliances for generating and applying electricity." ISAC LOUIS PULVERMACHER. Dated August 11. 10d. The improved battery which forms the object of this application for letters patent is composed of an indefinite number of elements joined together with chain-like articulation, so as to establish voltaic contacts between the zinc elements and the copper elements contained in each link, but in such a manner that the elements can be charged simultaneously with exciting liquid, and purged therefrom simultaneously.

3519. "Lighting gas by electricity." B. J. B. MILLS. (A communication from abroad by Lucien Alfred Wilhelmine Desruelles and Georges Jules Albert Eugène Bourdoncle, both of Paris.) Dated August 13. 2d. Has for its object the development of a system of lighting jets of gas by means of electricity in a simple, economical, and rapid manner. (*Provisional only.*)

CITY NOTES.

OLD BROAD STREET.

THE CONSOLIDATED TELEPHONE CONSTRUCTION AND MAINTENANCE COMPANY, LIMITED.—The general meeting convened on Friday, the 24th ult., at the offices, Lombard Street, Sir Julius Vogel presiding, was adjourned to the 24th instant. The chairman stated that the operations of the company ended on the 31st of March, but in the articles of association it was prescribed that unless otherwise determined the annual general meeting should be held in March. Clearly, however, they were not in a position to submit a statement of accounts to the shareholders before the end of the month. In future it would be arranged to hold the meetings somewhere between the 15th of April and the 15th of May.

THE EASTERN TELEGRAPH COMPANY, LIMITED, announce the payment on the 14th of April next of 3s. per share interest on the 6 per cent. preference shares, less income-tax, for the quarter ending March 31st, 1882; and an interim dividend of 2s. 6d. per share on the ordinary shares, free of income-tax, in respect of profits for the quarter ended December 31st, 1881. The half-yearly interest on the 6 per cent. debentures will be paid on the 15th of April next at the banking-house of Messrs. Glyn, Mills, Currie & Co.

CABLE BETWEEN TRIESTE AND CORFU.—A cable has been laid and opened for traffic between Trieste and Corfu, where it is connected with the submarine telegraphic system of the Eastern Telegraph Company. Messages were exchanged direct between Trieste and Zante, Syra, and Alexandria. This gives Austria direct submarine cable communication with Egypt and all parts of the Mediterranean.